DEPARTMENT OF THE INTERIOR

IRRIGATION

IN THE

NORTH-WEST TERRITORIES OF CANADA

1902

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DEPARTMENT OF PUBLIC WORKS,
REGINA, ASSA., N.W.T., November 19, 1902.

The Hon. CLIFFORD SIFTON, M.P.,
Minister of the Interior,
Ottawa.

SIR,—I have the honour to submit the following general report on irrigation and irrigation development in the North-west Territories up to date.

I have the honour to be, sir,
Your obedient servant,

ARTHUR L. SIFTON,
Commissioner of Public Works.

DEPARTMENT OF PUBLIC WORKS,
REGINA, ASSA., N.W.T., November 19, 1902.

A. L. SIFTON, Esq., M.L.A.,
Commissioner of Public Works,
Regina, Assa.

SIR,—I have the honour to submit herewith a general report regarding irrigation and irrigation development in the North-west Territories to date.

The subject of irrigation has now become so intimately associated with the present and future development of a large portion of the southern and south-western portions of the Territories, and information regarding the matter is being so widely asked for, that it has been thought well in preparing this report to endeavour to make it a handbook of information regarding the subject rather than to frame the report on the general lines followed in the majority of government reports dealing with special subjects.

With that end in view an effort has been made to eliminate purely technical matter, and to deal with the subject of irrigation in such a manner as to be of value to the rapidly increasing large number of immigrants who are interested in this important question.

The section of the report dealing with irrigation surveys is based upon detailed reports submitted from time to time by the staff of the irrigation surveys condensed into a connected form.

The information regarding climatology in the semi-arid region, canal and ditch construction, use of water for irrigation, results from irrigation, and the other general data dealt with has been compiled from reports of the Meteorological Service, from water right registers, ditch and canal inspections, returns from irrigators, and general inspections in the irrigable area made from time to time by myself and members of the staff of the Irrigation Branch of this department.

Your obedient servant,

J. S. DENNIS,
Deputy Commissioner of Public Works.

INTRODUCTION.

Irrigation is a subject which is entirely new to the residents of the older provinces of the Dominion, and to the majority of the large number of immigrants who are now flocking to the Territories.

The subject is also one that is but poorly understood or its importance appreciated even by the older settlers of the Territories, and interest in the matter is largely confined to those who have experimented with the growth of crops by the artificial application of water through irrigation, or who, after having had an object lesson as to the results obtained in that way, have purchased land under existing irrigation canals or ditches, or contemplate the construction of ditches of their own.

This condition of affairs is easily understood if it is remembered that extensive settlement in the semi-arid portion of the Territories is of comparatively recent date, and that the process of education as to the soil, climate and possibilities of the country has necessarily been slow.

The settlement which followed the construction of the Canadian Pacific Railway through the Territories in 1882 and 1883 was divided into two classes, that in the eastern portion of Assiniboia was mainly composed of farmers who intended to engage in the growth of wheat and other cereals, while the residents of the more westerly settlements in western Assiniboia and southern Alberta intended to devote their energies to stock-raising.

For some years stock-raising was the chief occupation of the settlers in the last mentioned districts, but by degrees small areas were brought under cultivation, and the growth of grain and fodder crops attempted. For two years after the settlers first located in that part of the Territories sufficient rainfall was experienced for the growth of crops, and the necessity for anything in the way of irrigation was not realized. Succeeding years, however, proved to be seasons of increasing drought, with total failures of crops, and finally they arrived at a stage when the statement 'that nothing could be grown' came to be generally accepted, and many of the settlers gave up their farms and moved away to the northern or eastern portions of the Territories, where the rainfall was found to be more certain. Some settlers, however, who had come from south of the international boundary where irrigation was common, or from mining regions of the mountains to the west and south, commenced experimenting by constructing small ditches for the irrigation of lands in the valleys of the smaller streams, and the results obtained caused the first interest in the subject of irrigation, and indicated that by that means bountiful crops could be produced.

From that small beginning irrigation in the Territories has grown until we now have 169 canals and ditches in operation comprising a total length of about 469 miles. These canals and ditches are capable of irrigating 614,684 acres of land, and the increased value of this land owing to the possibility of irrigation amounts to at least $1,850,000.

In the earlier years following the introduction of irrigation many doubts were expressed regarding the value or permanency of the results to be obtained from attempting to raise crops by that means, and even now those who have not had the object lessons provided by actual results, or have not studied the matter intelligently, are skeptical regarding the subject.

Irrigation has now, however, passed beyond the experimental stage, and the interests involved and possibilities attendant upon the extension of irrigation ditches and canals are so great that it seems desirable that a full and comprehensive hand-book regarding this important matter should be issued.

The following report has, therefore, been prepared to deal with the subject as far as possible in hand-book form, and every effort has been made to eliminate purely technical matter or discussions regarding irrigation engineering problems. It will, of course, be understood that in attempting to deal even in the most popular form with a subject like irrigation, a certain amount of scientific information must be given, but it will be found that the information of that kind included in the following pages forms part of the matter absolutely necessary to a correct appreciation or understanding of this important matter or its great possibilities in the present and future development of that portion of the Territories which we designate as semi-arid, and within which irrigation is now recognized as being necessary to ensure the production of crops during the majority of years.

To provide for continuity in dealing with the question, and to permit of ready reference, this report has been divided under distinct heads, the subject matter under these heads being arranged as far as possible so as to present the subject in the proper order of importance and facility for reference.

AREA, BOUNDARIES AND DESCRIPTION

OF

SEMI-ARID PORTION OF NORTH-WEST TERRITORIES

The portion of the Territories comprised within the semi-arid region includes an area of some 99,108 square miles, or 64,621,169 acres, situated in the southern and south-western part of the Territories, and its location is illustrated on the accompanying map.

The area is bounded as follows:—

Commencing at the intersection of third meridian with the international boundary; thence north, following the third meridian to the north boundary of Township 34; thence west, following the north boundary of Township 34 to the line between Ranges 8 and 9 west of the third meridian; thence north, following the line between Ranges 8 and 9 to the north boundary of Township 48; thence west, following the north boundary of Township 48, to the line between Ranges 10 and 11 west of the fourth meridian; thence south, following the line between Ranges 10 and 11 west of the fourth meridian to the north boundary of Township 34; thence west, following the north boundary of Township 34 to the western boundary of the province of British Columbia; thence south and south-easterly, following the said western boundary to its intersection with the international boundary line; thence east to the point of beginning.

The area embraced within the semi-arid region as above described contains what is generally spoken of as the ranching or grazing area of the west, and may be described in general terms as a vast open or prairie country, broken in its southern parts by the Wood Mountain and Cypress Hills, and including the foothills country adjoining the Rocky Mountains on the west. The district has a rapid rise to the west from an elevation of about 1,600 feet above sea level at its eastern limit to some 3,500 in the foothills region.

The district is intersected by several main drainage channels, including the South Saskatchewan, Bow, Belly, St. Mary, Oldman, Highwood and Red Deer rivers, and numerous smaller streams, but in many parts the surface water supply is scanty and of poor quality.

In portions of the Wood Mountain and Cypress Hills, and in the foothills region, timbered areas of greater or less extent are found, but these areas comprise but a small proportion of the area of the whole region. Grass of a more or less luxuriant growth is produced all through this vast area, and it may be said to be the largest unoccupied area producing grass and suitable for grazing of cattle, sheep or horses at large in Northern America.

The soil of the semi-arid region is, as a whole, of a most fertile character. In places sandy tracts of limited extent, and districts broken by sand hills and gravelly ridges are met with, but in general the soil consists of a rich alluvial loam, varying in depth, and overlying a sub-soil of clay and gravel.

In the Wood Mountain and Cypress Hills and foothills districts the country is more or less broken by ravines, and is what may be termed rough, but this roughness is

of marked value in providing the shelter required by stock during the winter months.

In the valleys of all the streams intersecting the region the bottom lands are of the richest character, consisting of black loam of great depth, and it is along these valleys that the larger number of the homes of the ranchers or settlers in the region are to be found.

In its general characteristics of soil and climate, in so far as temperature is concerned, the semi-arid region is well adapted for settlement, but it is lacking in the important feature of sufficient rainfall to assure the growth of crops each year. It is now known that during certain years there is sufficient rainfall to mature crops, and that in such seasons bountiful crops in certain districts have been harvested, but it is generally recognized that during the majority of years there is not the requisite amount of moisture to make agriculture successful, and that to ensure a crop water must be applied through irrigation.

In this sense the region is semi-arid, but its aridity constitutes one of the main features of attractiveness to the rancher or settler desiring to engage in dairy farming or pastoral pursuits.

The semi-arid region, as has already been stated, produces every year a bountiful crop of grass, the moisture from the melting snows and spring rains being sufficient to bring the growth of grass to a healthy condition before the hot and dry summer months. The effect of the lack of rainfall during these months which has led to the term 'semi-arid,' as applied to the region, is to rapidly cure the grass grown in the earlier part of the year in such a manner that its nutritive qualities are retained, and as a consequence stock thrive on this sun-dried grass in such a manner that beef fit for market is provided during fall and winter months direct from the range. This fact and the almost total absence of flies make the region an ideal district for the rancher and dairy farmer, but, as has already been intimated, the time has now come when these settlers, and the large number of new-comers who are making their homes in the semi-arid region, desire to be fully informed as to the possibilities of correcting nature's shortcoming in the way of rainfall by applying water artificially through irrigation to produce the fodder and other crops needed to make this large section of the Territories keep pace with the rapid development taking place in the more humid portions.

In discussing the question of irrigation, certain main features of temperature, rainfall, surface water supply, evaporation, and topography must first be considered, and these questions are dealt with under separate heads in the order given.

TEMPERATURE.

In the matter of temperature the area comprised in the semi-arid portion of the Territories is probably more favoured than the other parts of the Territories. Speaking generally, the summers are hot and the winters cold, but during the first mentioned season the nights are cool, and during the winter all parts of the region are subject, to a greater or less degree, to chinook winds, which blow from the west, and which for periods of ten of weeks' duration raise the temperature to almost summer-like conditions.

It is realized that in discussing the question of temperature tables showing thermometric means and extremes do not always convey to the average reader the most correct impression of existing conditions, but to permit of a condensed reference to the matter it is first necessary to quote certain temperature tables as a basis for such discussion. The following tables show the temperature observations since the establishment of meteorological stations in the Territories at widely separated points in the semi-arid region.

Maximum, Minimum and Mean Temperatures at Chaplin, Assa.—Elevation above Sea Level, 2,202 feet.

Year.	January.			February.			March.			April.			May.			June.			July.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1883																					
1884	40.0	43.0	2.3	41.0	41.0	6.2	45.0	23.0	14.3	70.0	15.0	37.6	85.0	32.0	56.0	100.0	45.0	66.7	85.0	43.0	65.5
1885	35.0	47.0	5.5	45.0	33.0	2.7	49.0	0.0	27.5							97.0	43.0		93.0	48.0	71.2
1886							70.0	20.0	29.6	75.0	10.0	42.6	96.0	28.0	54.3	95.0	40.0	62.3	110.0	37.0	63.0
1887	25.0	42.0	15.2	40.0	43.0	12.9	46.0	22.0	19.4	80.0	10.0	41.6	90.0	30.0	58.0	90.0	45.0	63.6	94.0	52.0	70.0
1888	45.0	40.0	10.0	40.0	40.0	7.2	42.0	20.0	8.7	65.0	0.0	33.4	75.0	35.0	51.1	90.0	40.0	60.2	97.0	56.0	68.0
1889	40.0	22.0	7.2	50.0	30.0	11.4	70.0	2.0	28.9	70.0	25.0	43.4	75.0	32.0	54.7	98.0	47.0	66.6	99.0	52.0	66.0
1890	40.0	30.0	5.4	47.0	34.0	−6.3	50.0	10.0	17.5	78.0	12.0	41.2	78.0	37.0	51.1	95.0	40.0	66.4	102.0	50.0	70.4
1891	54.0	5.0	22.7	15.0	30.0	11.1	45.0	32.0	10.8	81.0	18.0	49.5	90.0	27.0	57.7	80.0	40.0	59.2	86.0	50.0	66.3
1892	37.0	−38.0	0.7	34.0	20.0	6.8	57.0	5.0	20.7	62.0	25.0	38.7	65.0	30.0	42.2	84.0	40.0	63.8			
1893	40.0	49.0	3.6	34.0	45.0	5.3	50.0	24.0	10.3	60.0	10.0	35.3	82.0	27.0	55.3	90.0	38.0	65.3	160.0	40.0	70.2
1894	38.0	42.0	4.9	45.0	37.0	3.4	44.0	5.0	21.9	74.0	10.0	41.8	90.0	32.0	54.6	94.0	35.6	63.6	98.0	42.0	72.8
1895	37.0	37.0	9.0	44.0	34.0	0.3	62.0	15.0	22.2	78.0	32.0	53.9	79.0	27.0	49.8	90.0	32.0	54.4	102.0	34.0	62.6
1896	43.0	35.0	1.1	43.0	30.0	13.1	50.0	10.0	19.6	70.0	18.0	40.0	77.0	35.0	52.1	95.0	37.0	60.8	93.0	35.0	66.9
1897	30.0	37.0	2.0	25.0	27.0	4.5	43.0	13.0	6.9	83.0	18.0	41.3	92.0	27.0	57.2	94.0	37.0	66.0	98.0	42.0	66.0
1898	32.0	25.0	8.1	45.0	20.0	8.3	37.0	30.0	12.9	67.0	7.0	37.4	78.0	36.0	56.8	95.0	45.0	68.3	103.0	40.0	66.2
1899	43.0	32.0	1.8	45.0	42.0	5.8	22.0	24.0	0.6	67.0	10.0	35.6	75.0	27.0	49.0	84.0	35.0	57.5	102.0	37.0	67.2
1900	47.0	22.0	14.2	40.0	33.0	5.8	52.0	18.0	20.0	77.0	25.0	54.6	92.0	28.0	61.2	109.0	30.0	62.3	92.0	40.0	65.7
1901	37.0	32.0	0.1	42.0	25.0	4.8	47.0	12.0	24.0	78.0	18.0	43.9	92.0	30.0	61.7	80.0	35.0	53.0	93.0	37.0	67.8

Maximum, Minimum and Mean Temperatures at Chaplin, Assa.—Elevation above Sea Level, 2,202 feet—*Continued.*

Year.	August.			September.			October.			November.			December.			Annual.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1883..							65.0	22.5	37.6	50.0	30.0	15.1	15.0	30.0	7.4			
1884..	95.0	49.0	65.7	71.0	29.0	48.0	75.0	18.0	39.1	55.0	12.0	26.2	50.0	40.0	—4.6	100.0	43.0	31.24
1885.										65.0	18.0	36.6	50.0	11.0	20.2		47.0	
1886..	95.0	35.0	55.4	90.0	30.0	45.7	78.0	20.0	42.4	50.0	12.0	18.3	40.0	32.0	—0.5	110.0		
1887..	92.0	40.0	61.8	82.0	36.0	51.9	76.0	5.0	38.2	60.0	20.0	23.9	45.0	30.0	7.4	94.0	43.0	31.97
1888..	98.0	45.0	65.1	85.0	44.0	58.9	70.0	24.0	42.3	43.0	4.0	24.1	45.0	7.0	20.7	98.0	40.0	35.81
1889.	90.0	52.0	69.2	92.0	34.0	53.2	80.0	20.0	45.4	62.0	15.0	25.3	37.0	17.0	7.6	99.0	30.0	39.91
1890..	97.0	50.0	62.6	89.0	30.0	49.3	62.0	32.0	42.3	62.0	7.0	39.7	60.0	5.0	28.8	102.0	34.0	38.13
1891.	85.0	47.0	65.0	84.0	38.0	55.8	61.0	10.6	38.7	65.0	10.0	20.2	45.0	27.0	17.8	90.0	32.0	37.72
1892.							82.0	30.0	48.9	54.0	10.0	21.0	35.0	22.0	0.0		38.0	
1893..	109.0	29.0	61.8	95.0	28.0	54.4	72.0	15.0	39.0	48.0	38.0	16.5	37.0	38.0	1.1	109.0	49.0	34.21
1894..	107.0	37.0	68.2	82.0	27.0	52.2	65.0	25.0	42.3	60.0	23.0	22.5	40.0	12.0	14.7	107.0	37.0	37.19
1895..	93.0	28.0	59.2	87.0	24.0	47.2	72.0	0.0	39.0	60.0	15.0	20.6	50.0	15.0	10.9	102.0	37.0	34.30
1896..	87.0	37.0	57.5	83.0	27.0	49.3	78.0	15.0	39.2	44.0	40.0	1.1	44.0	20.0	19.0	95.0	40.0	34.60
1897..	100.0	35.0	64.3	83.0	27.0	54.9	78.0	12.0	42.7	68.0	33.0	14.0	43.0	37.0	6.2	100.0	43.0	35.00
1898..	93.0	37.0	61.7	82.0	27.0	52.5	70.0	22.0	37.2	50.0	30.0	19.9	43.0	23.0	11.9	103.0	30.0	36.80
1899..	82.0	35.0	56.6	78.0	27.0	49.5	72.0	18.0	37.0	64.0	17.0	36.2	50.0	12.0	13.5	102.0	42.0	33.13
1900..	87.0	38.0	60.1	75.0	24.0	46.4	60.0	25.0	40.1	55.0	20.0	20.6	40.0	17.0	16.8	109.0	33.0	38.02
1901.	92.0	37.0	65.3	80.0	25.0	45.8	72.0	18.0	45.2	52.0	5.0	25.6	42.0	33.0	14.4	93.0	33.0	37.62

MAXIMUM, Minimum and Mean Temperatures at Swift Current, Assa.—Elevation above Sea Level, 2,439 feet.

Year.	January.			February.			March.			April.			May.			June.			July.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1886	36·4	−39·0	−7·4	69·0	−25·4	18·9	63·0	−8·6	21·8	75·2	11·2	42·7	86·2	24·0	53·1	94·4	29·2	63·8	106·6	43·4	72·7
1887	37·0	36·0	−3·8	50·0	−42·4	7·7	56·0	19·0	23·3	75·0	9·6	39·1	85·4	26·0	51·8	82·6	26·4	58·5	90·0	34·8	64·3
1888	46·4	−40·2	−6·1	47·0	−24·0	13·0	55·6	−25·6	11·8	70·4	4·4	35·7	73·0	23·4	48·0	88·0	32·0	57·9	94·0	38·0	64·6
1889	38·2	−25·2	9·0	49·2	30·4	13·2	68·2	10·0	32·0	78·2	23·6	45·6	85·0	22·2	49·6	96·0	34·0	60·7	86·6	34·6	62·5
1890	37·4	−40·2	6·9	42·0	40·0	−4·1	46·6	10·0	19·0	76·4	7·0	38·3	78·2	17·2	49·1	94·4	35·4	62·6	100·6	34·4	68·1
1891	46·0	−25·0	19·2	31·4	30·0	−3·1	49·2	27·4	17·2	79·2	9·2	45·2	92·4	10·4	50·6	80·0	34·6	56·4	86·6	42·6	62·6
1892	45·4	34·6	6·6	39·4	21·4	8·7	53·4	−8·0	23·5	65·6	11·6	35·0	77·4	20·4	45·1	86·0	37·4	58·3	96·4	36·0	65·6
1893	36·2	−46·2	7·3	34·4	49·8	−1·6	43·2	−14·0	12·5	56·0	12·8	30·8	78·8	28·0	52·2	87·0	38·6	59·6	96·6	39·0	65·9
1894	44·0	32·6	2·8	40·4	27·6	8·4	51·0	10·0	20·0	78·0	18·0	42·2	89·0	26·0	53·6	91·6	39·4	63·8	101·6	41·0	70·3
1895	38·2	−30·2	3·5	48·0	34·0	7·0	57·0	16·0	23·5	77·4	21·0	47·8	84·6	28·0	51·7	93·6	30·0	57·0	98·0	45·0	65·0
1896	50·0	32·0	6·3	50·0	22·0	21·6	52·0	6·0	20·5	68·0	15·6	39·1	77·8	32·0	50·1	94·0	40·0	63·7	97·0	40·0	69·3
1897	40·0	40·0	9·6	34·0	20·0	10·5	40·6	−34·0	8·7	78·6	20·0	43·3	90·0	36·0	58·5	95·0	33·4	61·2	97·5	37·5	65·5
1898	33·0	12·8	17·2	41·3	20·0	12·3	41·5	20·0	13·4	73·0	2·0	36·4	79·5	26·0	52·0	95·0	34·0	59·8	98·5	40·8	66·3
1899	41·0	33·5	7·1	41·5	−41·5	2·5	41·0	−22·5	4·9	67·0	5·5	36·2	72·0	22·3	47·5	83·0	33·0	57·9	98·0	44·0	65·9
1900	59·0	16·5	21·7	40·0	35·0	4·2	66·0	16·0	23·1	74·5	23·5	46·7	90·0	28·0	57·5	104·0	32·0	65·8	95·0	40·0	66·6
1901	42·0	29·0	9·3	41·0	18·0	9·4	50·0	12·0	28·2	83·0	17·0	43·5	91·0	23·0	59·7	76·0	33·0	55·2	92·0	43·0	67·[illegible]

MAXIMUM, Minimum and Mean Temperatures at Swift Current, Assa.—Elevation above Sea Level, 2,439 feet—*Continued.*

Year.	August.			September.			October.			November.			December.			Annual.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1886..	91·6	31·2	64·7	86·0	19·0	49·3	82·0	13·0	41·6	66·0	12·0	22·7	40·4	33·0	7·6	106·6	39·0	37·62
1887..	85·4	36·4	59·3	81·4	25·4	53·1	76·4	4·0	36·0	67·4	27·0	23·4	42·4	30·6	7·0	90·0	42·4	31·73
1888..	95·0	35·4	61·6	86·0	28·0	55·5	77·6	12·0	39·7	48·8	0·4	23·0	58·0	7·0	19·7	95·0	40·2	35·37
1889..	95·7	32·8	65·7	88·6	21·5	50·9	88·7	11·9	42·7	62·0	8·0	25·3	48·0	17·0	11·0	96·0	30·4	39·02
1890..	92·8	35·4	61·0	86·0	16·4	49·3	71·9	22·0	39·1	64·0	3·4	32·5	55·1	3·4	24·2	100·6	40·2	36·02
1891..	92·0	34·6	62·2	89·4	30·0	54·1	72·4	9·0	38·8	55·6	14·0	20·3	43·4	18·6	17·6	92·4	30·0	36·76
1892..	96·0	40·0	63·3	85·0	30·0	54·0	82·4	16·6	42·4	62·8	10·0	19·6	32·0	32·8	7·7	96·4	34·6	35·90
1893..	101·0	35·4	64·6	96·0	18·0	49·9	67·0	13·2	33·9	60·0	31·0	16·6	41·2	36·4	13·6	101·0	49·8	33·78
1894..	97·0	42·0	68·3	86·0	26·0	50·6	74·0	20·0	38·0	63·4	13·0	22·5	42·0	7·0	15·8	101·6	32·6	38·03
1895..	91·6	36·0	62·1	88·0	24·0	48·7	78·8	10·0	42·4	56·0	12·0	24·4	54·0	20·0	15·8	98·0	34·0	36·80
1896..	88·0	32·0	61·6	82·0	28·0	50·2	81·6	20·0	42·7	44·0	30·0	4·0	48·0	20·0	23·8	97·0	32·0	37·70
1897..	96·0	35·0	67·2	85·0	28·0	58·1	76·4	14·5	43·7	66·0	32·0	15·2	40·0	30·0	14·8	97·5	40·0	38·00
1898..	93·2	41·3	65·9	84·0	28·0	54·1	68·0	16·0	37·3	48·0	18·0	22·0	43·0	19·0	17·7	98·5	20·0	37·90
1899..	80·0	36·5	59·4	81·0	27·5	55·0	82·0	12·3	38·2	60·0	20·0	39·8	47·3	15·0	16·8	98·0	41·5	35·52
1900..	95·0	39·0	62·9	80·0	23·0	51·4	70·0	13·0	43·6	59·0	22·5	19·8	45·0	21·0	24·2	104·0	35·0	40·79
1901..	94·0	38·0	65·7	83·0	24·0	46·8	72·0	17·0	48·3	60·0	4·0	29·2	44·0	27·0	19·5	92·0	29·0	40·19

MAXIMUM, Minimum and Mean Temperatures at Medicine Hat, Assa.—Elevation above Sea Level, 2,161 feet.

Year.	January.			February.			March.			April.			May.			June.			July.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1883																					
1884	44·3	31·5	11·1	45·5	38·1	9·4	50·0	21·9	18·5	62·0	19·7	39·9	84·9	32·0	57·4	97·1	44·1	65·2	86·3	40·7	63·6
1885	41·2	−41·0	3·4	46·7	−33·8	10·3	65·0	9·1	34·7	79·0	12·0	44·2	87·1	16·7	55·7	97·7	40·0	63·6	93·7	39·7	65·9
1886	41·2	50·5	−4·7	60·8	15·5	27·5	67·3	13·6	29·1	75·6	16·5	48·1	92·2	21·2	58·0	95·4	32·6	68·6	108·2	47·6	68·3
1887	41·8	39·9	0·1	42·6	50·7	7·9	58·0	18·6	30·4	78·6	18·7	44·4	93·7	29·7	56·7	85·5	35·0	60·2	89·9	36·3	66·6
1888	50·0	−39·9	2·1	42·2	22·7	20·3	58·0	−24·7	17·8	76·0	9·8	42·3	82·4	30·3	52·8	86·9	32·7	60·7	100·4	44·7	66·9
1889	48·4	23·6	10·5	55·8	34·1	16·2	70·9	0·0	36·2	80·0	25·4	50·9	85·5	30·7	55·0	96·5	38·7	65·9	87·9	42·0	66·1
1890	42·0	40·5	7·8	42·8	40·5	0·3	51·0	7·0	25·4	77·7	9·8	42·6	83·9	20·7	55·0	98·0	37·7	64·3	102·1	40·7	71·0
1891	53·7	13·8	24·6	35·6	32·0	0·0	54·5	35·0	22·9	82·8	17·4	50·4	90·2	18·7	54·9	88·0	38·4	61·1	90·6	42·6	68·5
1892	50·8	−35·1	14·0	48·7	14·6	15·0	61·9	1·1	31·8	70·8	14·7	39·1	84·4	16·9	48·4	93·5	35·8	62·2	96·1	39·1	67·8
1893	50·3	48·0	12·5	37·8	46·2	1·6	50·3	22·0	17·1	62·7	18·4	36·5	86·0	30·0	55·7	86·0	38·5	59·8	97·9	40·6	68·4
1894	48·2	−29·6	7·8	50·0	30·5	14·2	61·6	12·3	26·1	79·0	17·0	46·2	92·0	27·0	56·8	94·5	40·4	59·8	99·6	41·9	72·0
1895	45·7	32·5	0·7	56·1	36·5	10·8	69·0	−12·5	29·8	78·7	17·0	49·4	85·7	26·2	54·8	94·3	37·1	59·8	91·2	42·1	66·0
1896	52·6	35·0	9·2	59·5	−19·6	25·3	60·4	25·0	23·9	74·4	8·0	40·6	79·5	31·8	51·2	98·3	38·5	65·0	100·7	36·0	71·2
1897	49·7	−50·0	11·5	39·1	22·5	11·4	51·8	38·0	11·3	81·7	20·0	47·4	90·7	33·0	62·0	85·7	35·5	61·5	92·8	45·1	65·8
1898	39·9	16·0	19·6	48·3	25·0	16·0	43·8	20·0	17·6	77·8	0·0	41·9	80·8	28·0	54·8	94·8	31·4	61·9	101·8	44·1	69·3
1899	46·3	26·0	13·0	49·8	45·0	2·2	43·3	27·0	8·8	74·1	16·0	38·3	78·2	12·8	49·6	90·6	39·0	60·6	97·8	47·6	68·1
1900	62·0	18·0	24·6	45·0	34·9	9·0	63·8	16·1	28·7	80·5	26·8	50·5	86·0	33·0	58·3	106·6	37·0	67·0	101·8	44·1	69·0
1901	44·8	−32·0	15·4	53·0	17·0	14·9	59·5	6·5	34·5	80·4	15·5	45·1	88·6	27·7	58·7	78·6	31·5	55·0	91·8	41·2	67·0

MAXIMUM, Minimum and Mean Temperatures at Medicine Hat, Assa.—Elevation above Sea Level, 2,161 feet—*Con.*

Year.	August.			September.			October.			November.			December.			Annual.		
	Max.	Min.	Mean.	Max.	Max.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1883..	89·9	33·7	64·4	84·1	22·3	55·4	66·6	20·6	37·0	57·0	30·1	29·6	50·0	21·5	18·5			
1884..	93·1	38·4	64·8	75·5	23·0	48·4	79·9	10·2	43·2	66·0	12·5	32·4	61·0	50·0	0·6	97·1	50·0	37·77
1885.	95·2	39·2	65·3	93·2	24·3	57·2	81·2	12·7	45·2	61·7	11·1	38·1	68·0	18·8	28·4	97·7	41·0	42·67
1886..	95·2	35·0	70·2	85·2	28·5	54·8	82·8	18·6	45·7	63·2	23·6	27·5	48·5	36·5	14·2	108·2	50·5	42·27
1887..	91·3	36·7	62·8	83·0	29·1	57·5	78·0	10·0	42·0	68·0	35·3	28·3	47·2	23·3	12·4	93·7	50·7	37·78
1888.	97·0	42·0	64·0	92·8	29·0	58·2	84·9	13·3	41·7	55·1	1·1	23·5	56·1	7·8	19·6	100·4	39·9	38·64
1889..	94·9	34·5	65·8	89·5	31·7	53·4	92·7	20·7	46·0	69·5	1·6	29·4	47·7	28·6	13·6	96·5	34·1	42·42
1890..	91·5	41·2	65·0	88·8	25·0	52·6	71·7	22·0	42·5	68·0	0·9	36·5	62·0	1·2	28·6	102·1	40·5	39·67
1891..	92·8	38·2	66·1	94·0	28·7	56·3	73·5	9·5	43·7	60·8	11·8	25·1	55·6	23·3	22·5	91·0	35·0	41·31
1892.	97·0	40·3	64·3	89·2	28·1	55·4	84·0	17·0	43·7	67·7	15·4	23·8	41·2	25·0	10·8	97·0	35·1	39·69
1893..	104·0	36·7	66·6	90·6	23·0	51·4	68·8	6·0	38·4	60·4	34·6	19·6	46·7	33·0	18·2	104·0	18·0	37·15
1894..	98·2	46·1	70·6	89·2	26·8	52·8	75·1	20·0	41·6	72·7	5·0	28·6	50·2	40·9	21·3	99·6	30·5	41·48
1895..	92·5	34·5	63·7	86·7	24·0	51·4	78·7	8·0	46·1	63·6	13·0	28·2	59·6	22·0	20·2	94·3	36·5	40·00
1896..	90·2	38·0	65·2	89·2	25·0	53·4	81·5	16·5	45·2	53·6	36·0	2·0	52·6	25·0	26·5	100·7	36·0	39·90
1897..	99·5	33·8	69·9	90·0	28·0	58·8	78·8	0·0	45·4	67·2	26·0	15·5	46·8	31·0	18·0	99·5	50·0	39·90
1898..	95·8	44·2	69·4	86·8	30·0	56·6	67·8	14·0	40·5	62·8	11·0	23·2	59·8	23·0	20·5	101·8	25·0	40·90
1899..	82·6	37·0	61·3	86·6	32·0	59·1	84·8	11·0	42·2	67·8	22·0	42·7	50·8	25·0	22·0	97·8	45·0	38·99
1900..	97·0	32·0	63·4	81·3	17·5	53·4	75·8	18·5	44·9	67·8	31·5	23·6	53·8	9·0	31·3	106·6	34·9	43·64
1901..	94·3	41·0	67·9	87·8	26·5	49·6	76·8	23·1	50·8	60·8	7·0	32·8	54·8	13·0	27·3	93·4	32·0	43·25

MAXIMUM, Minimum and Mean Temperatures at Calgary, Alta.—Elevation above Sea Level, 3,406 feet.

Year.	January.			February.			March.			April.			May.			June.			July.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1885 ...	51·9	-34·7	7·8	56·9	-23·6	16·0	70·0	9·6	36·7	72·0	4·5	39·5	74·0	15·6	49·1	85·0	32·6	56·6	85·0	31·7	56·6
1886 ...	48·0	39·7	2·1	57·0	- 8·5	26·4	64·0	13·6	27·0	70·0	16·6	41·7	84·0	18·6	49·2	84·0	33·0	58·3	94·0	40·0	64·9
1887	39·0	31·7	4·0	56·0	42·7	4·1	75·0	-22·7	24·8	68·0	-15·6	38·6	90·0	23·1	49·6	84·5	28·0	53·5	84·5	32·7	60·3
1888	50·0	30·7	1·8	52·0	28·7	20·8	58·0	28·7	15·0	72·0	1·5	35·1	75·0	26·6	47·5	77·0	27·6	54·0	92·0	38·0	59·2
1889 ...	49·0	20·1	16·7	54·0	26·0	18·6	68·0	-6·0	35·0	73·0	15·0	44·6	78·0	25·0	49·3	89·0	30·0	57·6	84·0	35·0	59·3
1890	50·0	35·0	4·8	48·0	39·0	1·1	45·0	7·0	21·9	77·0	2·0	35·6	81·0	23·0	48·0	88·0	38·0	57·3	93·0	39·0	60·3
1891 ...	56·9	20·0	26·5	39·8	26·7	0·2	58·1	25·3	23·6	74·1	11·6	43·3	88·1	18·9	49·4	83·9	26·0	54·9	87·9	35·2	61·5
1892 ...	58·0	-18·4	14·5	51·9	-20·6	16·3	64·0	1·5	29·7	68·5	9·6	34·1	83·9	22·6	43·9	92·0	30·7	55·8	90·7	34·0	59·9
1893 ...	50·8	48·4	14·7	45·1	49·4	4·0	54·3	9·0	19·1	63·5	10·0	32·7	79·6	29·0	49·4	77·9	35·0	52·2	90·0	39·0	59·2
1894 ...	48·0	31·8	8·6	49·6	28·6	11·6	54·0	9·4	24·0	71·0	16·0	40·1	82·0	20·0	49·2	82·0	32·0	56·0	92·0	36·0	62·7
1895 ...	51·0	30·0	3·9	49·3	38·0	13·4	58·0	10·0	27·1	74·0	20·0	43·5	75·2	25·0	49·6	89·0	29·0	54·3	84·6	40·0	59·4
1896 ...	51·0	34·2	3·7	59·0	21·2	24·3	55·3	34·2	19·3	68·3	13·5	36·3	72·3	22·0	45·8	94·0	33·5	58·5	95·0	34·0	64·6
1897 ...	45·5	37·2	12·6	40·3	9·7	15·9	46·8	28·4	11·4	75·8	18·5	43·7	88·0	28·5	57·9	78·8	29·8	57·0	86·3	39·0	59·2
1898	44·3	8·0	20·9	44·8	20·0	14·5	42·3	18·0	17·8	76·0	4·0	38·2	76·0	22·0	49·1	84·3	35·0	56·4	94·3	38·0	62·6
1899	49·0	25·0	13·2	55·0	40·0	2·4	49·0	-20·0	8·8	70·0	14·0	33·8	71·0	12·0	44·4	77·0	34·0	53·2	89·0	35·0	60·3
1900 .	50·0	15·0	22·1	50·0	27·0	11·4	60·0	22·0	28·2	76·0	21·0	44·1	79·0	28·0	51·8	92·0	30·0	57·6	85·0	36·0	58·2
1901 .	45·0	35·0	16·6	57·0	18·0	15·6	55·0	10·0	30·4	72·0	13·0	38·7	85·0	20·0	52·5	77·0	32·0	50·4	80·0	37·0	58·9

MAXIMUM, Minimum and Mean Temperatures at Calgary, Alta.—Elevation above Sea Level, 3,406 feet—*Continued.*

Year.	August.			September.			October.			November.			December.			Annual.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1885..	87·0	34·7	56·9	84·0	23·7	48·9	73·0	12·6	40·3	65·0	1·5	32·7	49·0	11·0	3·5	87·0	34·7	37·05
1886..	85·0	28·1	59·4	80·0	27·6	49·4	81·0	8·0	40·8	64·0	30·0	27·1	51·0	31·7	14·4	91·0	39·7	38·04
1887..	80·3	32·2	56·8	82·5	23·6	50·3	77·0	7·5	39·9	65·0	24·7	25·6	48·0	20·5	9·0	92·0	42·7	33·86
1888..	90·0	38·0	58·8	89·0	27·6	53·8	79·0	6·5	37·2	58·0	12·6	29·9	53·0	0·5	21·3	92·0	30·7	35·15
1889..	89·0	32·0	58·8	86·0	23·0	48·7	85·0	14·0	44·3	69·0	0·0	27·7	47·0	16·0	13·9	89·0	26·0	39·54
1890..	87·0	32·9	58·0	83·7	29·6	49·0	70·0	10·7	38·0	70·0	0·5	37·9	57·9	3·8	25·8	93·0	39·0	35·68
1891..	88·0	36·7	58·2	81·4	24·4	50·8	76·9	5·6	42·1	56·9	14·6	23·2	45·9	25·6	18·8	88·1	26·7	37·71
1892..	90·7	35·2	57·8	85·6	15·4	50·4	81·8	7·2	40·0	68·3	24·8	19·0	49·2	33·7	12·0	92·0	33·7	36·12
1893..	94·7	34·0	60·5	86·0	27·0	48·3	61·4	1·4	34·8	53·3	30·8	17·9	48·0	30·1	17·7	94·7	49·4	31·76
1894..	92·0	39·5	62·3	79·0	25·5	46·2	68·0	17·5	39·1	67·0	10·5	24·3	49·0	5·5	18·9	92·0	31·8	37·17
1895..	83·0	33·0	57·3	79·3	23·0	44·9	76·0	19·0	45·5	65·0	13·7	27·5	49·2	11·1	19·6	89·0	38·0	37·20
1896..	85·3	38·0	60·0	85·0	24·0	49·3	73·3	16·5	41·3	47·3	29·2	2·4	48·8	15·5	26·1	95·0	34·2	36·00
1897..	90·3	34·5	62·7	79·6	26·0	52·4	73·3	6·0	42·2	59·0	25·7	12·3	45·3	26·0	18·2	90·3	37·2	37·10
1898..	87·0	33·0	63·0	81·0	24·0	51·8	61·0	14·0	35·9	48·0	23·8	21·7	56·0	31·0	21·4	94·3	31·0	37·80
1899..	78·0	30·0	53·7	77·0	32·0	53·6	77·0	4·0	36·7	58·0	11·0	37·1	56·0	24·0	19·2	89·0	40·0	34·70
1900..	90·0	30·0	55·1	77·0	17·0	47·8	71·0	11·0	38·1	64·0	30·0	20·6	50·0	3·0	27·8	92·0	30·0	38·57
1901..	85·0	35·0	59·3	75·0	23·0	45·3	74·0	18·0	47·9	60·0	-5·8	28·4	60·6	3·8	26·3	85·0	35·0	39·19

MAXIMUM, Minimum and Mean Temperatures at Macleod, Alta.—Elevation above Sea Level, 3,060 feet.

Year.	January.			February.			March.			April.			May.			June.			July.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1895																					
1896	26·9	—1·0	13·0	61·0	—17·0	31·1	60·0	—31·0	24·8	71·0	8·0	39·5	74·0	30·0	48·2	98·0	34·0	62·2	102·0	41·0	69·6
1897	50·0	—41·0	18·6	46·0	—13·0	24·1	56·0	—30·0	18·0	75·0	23·0	46·2	89·0	31·0	60·2	80·0	31·0	59·3	87·0	40·0	62·7
1898	46·0	—13·0	27·2	50·0	—18·0	22·2	49·0	—17·0	19·3	76·0	14·0	43·1	76·0	25·0	51·1	85·0	34·0	58·3	98·0	43·0	66·7
1899	50·0	—31·0	18·6	50·0	—36·0	6·2	47·0	16·0	14·3	66·0	10·0	37·1	71·0	15·0	49·5	83·0	38·0	57·1	96·0	41·0	65·2
1900	58·0	—16·0	28·0	46·0	—32·0	15·0	64·0	—17·0	30·6	77·0	22·0	47·1	81·0	32·0	55·4	98·0	33·0	62·1	94·0	43·0	63·5
1901	51·0	30·0	19·4	58·0	—25·0	17·5	61·0	15·0	33·8	75·0	15·0	41·1	84·0	22·0	55·2	79·0	31·0	52·1	94·0	38·0	63·8

MAXIMUM, Minimum and Mean Temperatures at Macleod, Alta.—Elevation above Sea Level, 3,060 feet—*Continued.*

Year.	August.			September.			October.			November.			December.			Annual.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1895	90·0	36·0	61·0	84·0	20·0	46·0	85·0	18·0	43·5	79·0	10·0	30·8	58·0	23·0	24·6			
1896	89·0	41·0	63·9	89·0	29·0	52·2	77·0	19·0	47·3	54·0	—33·0	4·7	63·0	22·0	33·0	102·0	33·0	40·80
1897	96·0	38·0	67·5	84·0	30·0	57·5	82·0	6·0	47·6	65·0	27·0	17·9	46·0	27·0	21·8	96·0	41·0	41·80
1898	92·0	41·0	67·2	83·0	32·0	56·9	62·0	14·0	40·7	50·0	19·0	28·2	56·0	30·0	25·5	98·0	30·0	42·20
1899	80·0	37·0	57·5	83·0	31·0	57·5	80·0	2·0	41·4	65·0	16·0	42·6	50·0	—25·0	21·2	96·0	36·0	39·04
1900	90·0	30·0	59·9	83·0	20·0	51·8	72·0	13·0	43·2	65·0	29·0	25·7	56·0	2·0	34·2	98·0	32·0	43·07
1901	94·0	40·0	64·4	83·0	28·0	46·6	77·0	22·0	50·5	60·0	2·0	35·3	53·0	4·0	28·8	94·0	30·0	42·38

The foregoing tables, it will be noted, give the highest, lowest and mean monthly temperature for each month in the year for many years past, and a study of them will indicate the existing conditions during the summer and winter months, or during the summer months of plant growth.

For more ready reference, however, by those who are looking for general information only, a table is appended showing the average maximum, minimum and mean temperature during the years included in the more extended tables previously given.

Point.	Number of Years Observation.	Average Maximum Temperature.	Average Minimum Temperature.	Average Mean Temperature.
Chaplin	9	102·22	—38·22	35·65
Swift Current	16	97·78	—35·67	36·94
Medicine Hat	18	99·13	—39·70	40·41
Calgary	17	91·08	—35·22	36·62
Macleod	6	97·33	—33·66	41·55

The information contained in the last table, while condensed in form, will probably convey to the ordinary reader a more correct appreciation of existing conditions, if he is able to compare the averages quoted with the same averages for points in other portions of Manitoba and the Territories, and in Ontario and the States lying immediately south of us, which are here quoted.

Point.	Number of Years Observation.	Average Maximum Temperature.	Average Minimum Temperature.	Average Mean Temperature.
Toronto, Ontario	19	91·70	—13·17	43·72
Winnipeg, Manitoba	19	93·33	—42·81	34·00
Regina, Assiniboia	16	92·88	—45·42	32·90
Prince Albert, Saskatchewan	11	90·58	—49·97	40·48
Edmonton, Alberta	17	88·55	—42·12	35·89
Denver, Colorado	20	72·40	—27·80	49·05

Some of the facts which are disclosed by the full temperature tables given above for Chaplin, Swift Current, Medicine Hat, Calgary and Macleod are deserving of special notice, as they tend to prove conclusively the general statement already made, that from the standpoint of temperature the semi-arid region is well adapted to agricultural pursuits, and specially suited to the grazing of cattle, horses or sheep at large.

It will be noted in the first place that the information given in the tables indicates a defined winter period extending from November to March, and that during these months the cold is sometimes intense, the thermometer indicating temperatures of 20° to 40° below zero. It will, however, at the same time be noted that at all the points for

which temperature tables are given, the winter months indicating the lowest temperatures also show temperatures ranging from freezing to as high as 69°, clearly indicating the marked influence of the warm chinook winds, and illustrating the possibility of stock running at large during these winter months.

The information given regarding temperatures during the months April to October should, of course, be taken in conjunction with detailed information regarding the humidity of the air and the duration of sunshine to permit of a proper understanding of the suitability of the district for agriculture, but sufficient data is given to enable the inquiring mind to see that extremes of temperature during all these months are not too great for the growth of cereal and fodder crops, and that under ordinary conditions of rainfall the area would be an attractive one to the agriculturist.

Speaking generally of the climate of the semi-arid region from the standpoint of temperature, it may be said to possess many attractive points. The extremes of temperature, both during summer and winter months, are sometimes very marked, but these changes probably add much to the attractiveness of the district, and the general healthiness of the region is now well recognized.

The daily range of temperature is great throughout the whole region, and the temperature of the day is much greater than that of the night. This condition is due largely to the elevation of the district above sea level, and to the extreme dryness of the air, which allows radiation to proceed with extreme rapidity so soon as the sun sets.

RAINFALL.

In discussing the rainfall in the semi-arid region as set out in accompanying tables, it will be noted that rain and snow are both included under the usual term 'precipitation.'

The tables are given in the same order as those for temperature at points in the district, viz.:—Chaplin, Swift Current, Medicine Hat, Calgary and Macleod.

CHAPLIN—Elevation above Sea Level, 2,202 feet.

Year.	Jan.	Feb.	Mar	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1883	..	..					....			1·45	0·25	0·50	
1884	1·10	2·45	0·42	0·42	0·11	4·03	1·83	2·49	3·62	1·43	0·44	0·60	18·94
1885	0·90	0·56	0·03	0·47		-	1·10		--		0·13	0·60	--
1886				1·20	0·95	0·76	0·75	0·95	0·22	0·04	0·44	1·12	
1887	0·95	0·70	0·80	0·39	0·54	1·29	0·00	0·17	0·05	0·23	0·00	0·25	5·37
1888	0·63	0·55	0·55	0·60	1·13	0·45	0·10	0·18	0·00	0·57	0·10	0·05	4·91
1889	0·20	0·25	0·40	0·35	1·58	0·09	0·15	0·00	0·06	0·00	0·08	0·62	3·78
1890	0·20	1·10	0·30	0·10	0·15	1·36	0·09	0·21	0·17	1·58	0·00	0·00	5.26
1891	0·35	0·70	R	0·49	0·27		1·90		0·08	0·99	0·30	0·30	—
1892	0·00	0·20	0·20	0·80	0·04	0·51	0·00		—	0·00	0·77	0·20	
1893	0·44	0·60	0·10	0·05	0·04	0·17	0·22	0·26	0·03	0·25	0·50	0·25	2·91
1894	0·25	0·20	0·66	0·86	0·24	0·19	0·00	0·08	0·21	0·89	0·50	0·00	4·08
1895	1·35	0·35	0·10	0·27	1·41	0·38	0·48	0·03	0·22	0·05	0·39	0·55	5·58
1896	0·45	0·25	0·65	1·22	3·30	0·52	0·36	1·09	0·19	0·08	1·35	0·20	9·66
1897	0·43	1·00	0·60	0·15	0·00	0·24	0·24	0·05	2·24	0·87	0·74	0·00	6·56
1898	0·10	0·40	1·30	0·00	0·03	2·33	0·13	0·15	1·09	0·25	0·62	0·00	6·40
1899	0·55	0·10	0·70	0·09	1·47	0·59	1·19	0·31	0·06	0·61	0·08	0·15	5·90
1900	0·00	1·00	0·30	0·23	0·22	0·25	0·10	0·55	0·72	0·60	0·60	0·20	4·77
1901	0·70	0·20	0·05	0·37	0·16	0·63	0·43	0·00	1·08	0·10	0·10	0·60	4·42
Total for 9 years....	4·27	4·10	4·46	3·24	6·87	5·30	3·15	2·52	5·84	3·70	4·88	1·95	50·28
Monthly Means....	0·474	0·456	0·496	0·360	0·763	0·589	0·350	0·280	0·649	0·411	0·542	0·217	5·587

SWIFT CURRENT—Elevation above Sea Level, 2,439 feet.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual.
1886	0·45	0·70	0·50	2·03	1·86	0·85	1·35	0·60	0·50	0·32	0·80	0·68	10·62
1887	0·87	1·49	0·51	1·60	1·56	3·85	3·70	1·62	1·44	0·64	0·11	0·62	18·01
1888	0·51	0·84	1·14	0·68	0·63	4·92	0·67	2·34	0·38	1·32	0·28	0·38	14·09
1889	0·65	0·38	0·68	0·52	2·42	1·44	2·77	R	0·10	R	0·31	1·19	10·46
1890	0·84	0·74	0·68	0·74	1·30	3·44	0·88	2·70	1·82	3·96	0·24	0·16	17·50
1891	0·36	0·44	1·44	1·52	1·16	6·80	3·36	3·26	1·64	2·07	1·32	1·24	24·55
1892	0·34	0·94	0·40	3·33	3·16	3·96	1·00	1·70	0·54	0·12	1·70	3·00	20·25
1893	1·34	1·26	0·78	0·24	0·37	0·57	3·22	2·28	0·56	1·53	0·70	1·02	13·87
1894	0·40	0·50	1·02	0·95	2·64	1·35	0·62	0·56	0·63	0·40	0·22	0·37	9·66
1895	1·29	0·50	0·20	0·04	1·77	3·02	3·32	0·34	0·97	0·04	0·24	0·50	12·23
1896	0·72	1·04	0·42	0·93	2·90	1·40	0·26	2·68	2·08	0·02	1·38	0·28	14·11
1897	0·57	0·84	0·24	0·08	0·26	0·83	6·27	1·28	2·60	0·88	1·50	0·89	16·24
1898	0·57	0·82	2·02	0·60	1·31	2·56	2·81	1·79	0·90	1·33	0·41	0·13	15·25
1899	0·62	0·30	1·31	0·25	2·49	3·17	3·95	4·75	0·44	1·07	0·70	0·33	19·38
1900	0·14	0·36	0·57	0·42	2·49	1·38	2·42	2·75	2·48	0·47	0·46	0·66	14·60
1901	1·32	0·50	0·30	0·42	1·90	4·18	4·29	0·56	3·84	0·46	0·22	0·50	18·78
Total for 16 years.	10·97	11·65	12·41	14·35	28·22	43·52	40·89	29·21	21·12	14·63	10·48	12·01	249·46
Monthly Means..	0·684	0·728	0·776	0·897	1·764	2·720	2·556	1·826	1·320	0·914	0·655	0·751	15·591

MEDICINE HAT—Elevation above Sea Level, 2,161 feet.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1883..										0·96	0·35	0·24	
1884..	0·50	0·70	0·86	0·19	1·39	2·21	2·64	1·19	3·84	0·27	0·96	0·40	14·95
1885..	0·68	0·39	0·56	0·85	0·13	3·51	1·60	1·49	0·04	0·10	0·02	0·00	9·37
1886..	0·00	0·00	0·32	0·80	1·41	1·55	0·78	0·11	0·19	0·79	0·51	0·28	6·72
1887..	0·30	0·00	0·00	0·63	0·12	5·75	0·29	0·98	0·41	0·46	0·25	0·70	9·89
1888..	0·45	0·62	0·90	0·20	2·20	3·22	4·78	1·00	0·06	0·66	0·18	0·40	14·67
1889..	0·10	0·20	0·43	1·00	2·66	0·23	1·92	0·00	0·28	0·00	0·42	0·77	8·01
1890..	0·42	0·31	0·50	0·03	0·33	3·30	0·50	2·10	0·93	0·58	R	0·13	9·13
1891..	0·19	1·51	1·31	0·37	1·13	4·34	1·28	1·62	1·14	0·20	0·30	0·36	13·75
1892..	0·16	0·40	0·31	1·48	1·03	0·89	1·87	3·00	0·22	0·04	1·40	1·42	12·22
1893..	1·72	0·70	0·23	0·77	1·09	2·25	2·53	2·17	0·34	0·41	1·23	1·16	14·60
1894..	0·58	0·92	0·99	0·54	1·33	2·25	0·39	0·81	2·18	0·81	1·08	0·06	11·94
1895..	0·88	0·91	1·19	0·26	0·55	2·31	4·86	0·24	1·88	0·29	0·52	0·24	14·13
1896.	1·38	1·24	1·01	2·26	3·10	1·59	1·11	1·79	1·74	0·55	2·12	0·29	18·18
1897.	0·74	0·41	0·52	0·59	0·59	5·02	1·65	0·40	2·17	1·26	3·11	0·43	17·27
1898..	0·45	1·07	1·62	1·42	0·48	1·51	2·45	2·22	1·07	1·71	1·23	0·67	15·90
1899..	1·12	1·13	1·17	0·87	3·32	2·60	3·79	4·66	1·68	0·80	0·31	0·91	22·28
1900	0·47	1·04	1·05	1·25	1·62	2·26	2·67	5·67	1·92	1·02	1·95	1·15	22·05
1901..	1·68	1·40	0·52	0·11	6·29	4·01	2·82	0·26	2·41	0·45	0·55	0·30	20·80
Total for 18 years.	11·82	12·75	13·49	13·42	28·77	49·38	37·93	29·03	22·46	10·38	16·14	9·67	255·24
Monthly Means..	0·657	0·708	0·750	0·745	1·598	2·743	2·107	1·613	1·248	0·577	0·897	0·537	14·180

CALGARY—Elevation above Sea Level, 3,406 feet.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1885	0·65	0·96	0·84	0·49	0·41	2·15	3·70	3·06	R	R	0·30	0·35	12·91
1886	0·18	0·28	1·03	1·16	1·72	3·30	0·20	0·00	0·76	0·79	0·35	1·55	11·32
1887	0·92	0·19	0·35	0·22	0·70	2·15	3·54	2·19	0·54	0·13	0·99	0·77	13·69
1888	0·24	1·76	0·90	1·67	2·05	3·70	3·23	2·08	0·23	1·01	0·41	0·23	17·51
1889	0·92	0·75	1·50	R	2·04	0·61	2·37	R	1·39	0·52	0·12	1·37	11·59
1890	0·88	0·85	0·82	0·71	2·13	2·27	2·21	3·47	0·51	0·86	0·17	0·06	14·94
1891	0·20	0·50	R	0·07	1·38	2·20	2·81	1·58	0·77	0·27	0·20	0·46	10·44
1892	0·03	0·03	0·07	0·60	0·06	1·07	2·40	1·10	0·50	0·66	1·30	0·09	7·91
1893	0·55	0·20	0·15	0·47	2·47	1·11	1·95	0·88	0·76	0·74	1·20	0·57	11·05
1884	0·41	0·03	0·67	0·96	4·05	1·10	0·10	1·47	1·30	0·11	1·11	0·40	11·71
1895	0·96	0·57	0·70	0·58	0·34	1·97	4·97	1·18	2·53	0·21	0·49	0·62	15·12
1896	0·90	1·94	1·13	0·64	1·94	1·22	1·84	1·66	1·46	0·70	2·26	0·36	16·05
1897	0·53	0·46	0·26	0·31	0·18	6·13	5·54	2·13	1·04	0·76	2·54	0·70	20·58
1898	S	0·90	1·57	0·29	2·05	3·21	3·87	2·17	0·54	0·28	0·30	0·40	15·58
1899	0·85	0·30	1·13	0·40	5·44	3·52	2·11	9·40	0·99	1·31	0·26	0·44	26·15
1900	0·25	0·40	0·40	2·04	1·32	3·56	2·02	1·29	3·99	0·40	1·80	0·10	17·57
1901	0·40	1·02	1·15	0·90	1·91	7·00	3·90	0·71	2·95	0·12	0·40	1·85	22·31
Total for 17 years	8·87	11·14	12·67	11·51	30·19	46·27	46·76	34·37	21·26	8·87	14·20	10·32	256·43
Monthly Means	0·522	0·655	0·745	0·677	1·776	2·722	2·751	2·022	1·250	0·522	0·835	0·607	15·084

MACLEOD—Elevation above Sea Level, 3,060 feet.

Year.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1896	0·15	0·53	0·70	0·40	2·71	0·48	1·27	1·99	2·23	0·41	1·70	0·10	12·73
1897	0·10	0·10	0·58	1·20	0·00	4·20	2·16	0·15	0·92	0·33	2·40	0·63	12·77
1898	0·30	0·53	1·00	0·27	1·59	1·90	1·57	4·04	0·85	0·58	0·15	0·80	13·58
1899	1·08	0·25	1·10	0·70	3·43	1·92	4·13	2·40	1·75	1·67	0·05	1·26	19·74
1900	0·13	0·70	0·43	0·60	0·81	0·28	2·67	0·64	2·39	0·78	0·60	0·05	10·08
1901	0·26	0·58	0·35	0·80	2·06	4·31	1·24	0·43	1·91	0·04	0·45	0·50	12·93
Total for 6 years	2·02	2·69	4·16	3·97	10·63	13·09	13·04	9·65	10·05	3·84	5·35	3·34	81·83
Monthly means	0·336	0·448	0·693	0·662	1·772	2·182	2·173	1·608	1·675	0·640	0·892	0·557	13·658

It is upon the information disclosed by the foregoing tables that the proof of the semi-aridity of the large portion of the Territories dealt with in this report is based. A careful perusal of these tables indicates certain main facts which are summarized to permit of a clearer understanding of the remarks which follow. These facts relate to the total average annual precipitation at the points mentioned during the years covered by the observations; the average annual precipitation during the months of May, June, July and August for the same period; the smallest and greatest precipitation during the years included in the period, and the duration of the cycle of least and greatest precipitation.

TOTAL Average Annual Precipitation.

Point.	Number of Years.	Total Average Annual Precipitation in Inches.
Chaplin	9	5·587
Swift Current	16	15·291
Medicine Hat	18	14·180
Calgary	17	15·084
Macleod	6	13·638

TOTAL Average Annual Precipitation during May, June, July and August at above points.

Point.	Number of Years.	Total Average Annual Precipitation.			
		May.	June.	July.	August.
		Inches.	Inches.	Inches.	Inches.
Chaplin	9	0·763	0·589	0·350	0·280
Swift Current	16	1·764	2·720	2·556	1·826
Medicine Hat	18	1·598	2·743	2·107	1·613
Calgary	17	0·776	2·722	2·751	2·022
Macleod	6	1·772	2·182	2·173	1·608

EXTREMES of Total Annual Precipitation at above points.

Point.	Year.	Smallest.	Year.	Greatest.
		Inches.		Inches.
Chaplin	1893	2·91	1896	9·66
Swift Current	1889	10·46	1891	24·55
Medicine Hat	1886	6·72	1899	22·28
Calgary	1892	7·91	1899	26·15
Macleod	1900	10·08	1898	13·58

CYCLE of Least and Greatest Precipitation as indicating by tables above.

CHAPLIN.

Year.	Smallest.	Year.	Greatest.	Number of Wet Years.	Number of Dry Years.
[illegible]	2·91	1896	9·66	....	3
[illegible]	4·42	1896	9·66	3	3

SWIFT CURRENT.

Year.	Smallest.	Year.	Greatest.	Number of Wet Years.	Number of Dry Years.
1887....	10·46	1891	24·55	3	2
1891....	9·66	1897	24·55	3	4
1897....	14·60	1901	18·58	5	

MEDICINE HAT.

Year.	Smallest.	Year.	Greatest.	Number of Wet Years.	Number of Dry Years.
1884....	6·72	1891	14·93	3	5
1891....	11·94	1896	18·18	4	2
1896....	17·27	1901	22·28	6	

CALGARY.

Year.	Smallest.	Year.	Greatest.	Number of Wet Years.	Number of Dry Years.
1885....	10·44	1891	17·51	3	4
1891....	7·91	1897	20·58	3	4
1897....	15·58	1901	26·15	5	

MACLEOD.

Year.	Smallest.	Year.	Greatest.	Number of Wet Years.	Number of Dry Years.
1896....	10·08	1901	19·74	2	4

The question of the semi-aridity of the Territories with which we are dealing is a question of first importance, and one which must be entirely removed from the sphere of probabilities before the large area affected will develop along the lines of least resistance. For many years the idea of semi-aridity was vigorously combatted by settlers within the district, by railway corporations owning land therein, and by some of the government officials who through insufficient information assumed that the admission of semi-aridity would prevent any development in the district. However, actual experience in the attempts made to produce crops watered only by nature's showers has now convinced even the most sceptical that during certain years at least such efforts are futile, and that during the majority of years the moisture supplied by rainfall during the months of crop growth must be augmented if good crops are to be obtained.

These facts are clearly indicated in the tables given above, but to make them thoroughly understood certain facts disclosed by the figures quoted are given.

It will be noted in the first place that the average annual precipitation shown at the different points would, with the exception of Chaplin, at first glance indicate that there is sufficient moisture for crop growth. That opinion, however, will be dispelled by an examination of the table relating to the precipitation during the months of May, June, July and August. Discarding the results for Chaplin, as both the average annual precipitation and monthly means for the months mentioned are entirely below the limit of plant requirements, it will be noted that the total rainfall for the years mentioned during the months of May, June, July and August at the four remaining points has been as follows:—

	Inches.
Swift Current	8·866
Medicine Hat	8·061
Calgary	8·271
Macleod	7·735

This rainfall, if it could be depended upon each year, and was distributed through the months of growth as shown in the statement, would probably be sufficient to mature crops, but proceeding to the third table, the wide range in the average annual precipitation will be noted, and it will be readily understood that during any year in which the total annual precipitation falls below 10 inches, the chances of maturing crops dependent entirely on the rainfall are very poor.

The fourth table has been prepared to show, if possible, in a graphic form that there is a defined cycle of wet and dry seasons in the semi-arid region, and that the recurrence of such seasons can be foretold with some degree of certainty.

The period covered by the meteorological observations as noted above does not, of course, cover a sufficient number of years to enable us to speak authoritatively on this point, but as far as they go they are worthy of consideration.

It will be seen from the table given that at all the points under discussion there is a cycle of wet and dry seasons varying in length from three to six years, and that this recurrence of wet and dry periods is well established at all the points for which data is available. The fact that the past four years have comprised one of the wet cycles is also very apparent from the tables, and it may with safety be assumed that the coming three or four years will fall below the maximum in precipitation, and comprise one of our dry cycles.

EVAPORATION.

Evaporation is a subject which is closely allied with the use of water for irrigation, and must be considered in connection with the subject of the water supply available for that purpose. Contrary to the generally accepted theory it may be stated that differences of climate do not seem to have much effect upon the loss of water from this cause. We have, so far, very little in the way of investigation of this climatic condition in the Territories to guide us, but what is available would seem to indicate that the loss from evaporation with us does not vary very much from loss through a similar agency in the irrigable states to the south of us, and that we must figure on an annual loss of from 3 to 5 feet of water from that cause.

The observations for evaporation which we have so far taken, and which are given below, cover, as will be noted, only summer months, and a short period of time, but they agree fairly well with the investigations of this matter in the western United States, and indicate a loss, as stated, during the year of from 3 to 5 feet.

EVAPORATION Observations, 1896.—Calgary—Station No. 1—Pan in water.

Interval.	Excess of Evaporation over Precipitation.	Excess of Precipitation over Evaporation.	Precipitation.	Total Evaporation.
	Inches.	Inches.	Inches.	Inches.
May 18—May 29	1·626	.....	0·46	2·086
May 29—June 29	3·354	.....	1·22	4·574
June 29—July 30	1·704	.....	1·84	3·544
July 30—August 31	1·188	.....	1·66	2·848
August 31—September 29	1·200	.....	1·46	2·660
September 29—October 23	1·224	.....	0·70	1·924
Totals	10·296	.....	7·34	17·636

EVAPORATION Observations, 1896.—Calgary—Station No. 2—Pan in ground.

Interval.	Excess of Evaporation over Precipitation.	Excess of Precipitation over Evaporation.	Precipitation.	Total Evaporation.
	Inches.	Inches.	Inches.	Inches.
May 21—May 28	0·894	.....	0·46	1·354
May 28—June 29	3·060	.....	1·22	4·280
June 29—July 27	2·148	.....	1·84	3·988
July 27—August 31	1·284	.....	1·66	2·944
August 31—September 29	0·900	.....	1·46	2·360
September 29—October 23	3·312	.....	0·70	4·012
Totals	11·598	.....	7·34	18·938

EVAPORATION Observations, 1898.—Calgary—Station No. 1—Pan in ground.

Interval.	Excess of Evaporation over Precipitation.	Excess of Precipitation over Evaporation.	Precipitation.	Total Evaporation.
	Inches.	Inches.	Inches.	Inches.
June 8—June 29	0·792	.....	3·21	4·002
June 29—July 31	2·604	.....	3·87	6·474
July 31—August 30	2·160	.....	2·17	4·330
August 30—September 30	2·688	.....	0·54	3·228
September 30—October 31	6·576	.....	0·28	6·856
October 31—November 5	0·372	.....	0·00	0·372
Totals	15·192	.....	10·07	25·262

EVAPORATION Observations, 1899.—Calgary—Station No. 1—Pan in ground.

Interval.	Excess of Evaporation over Precipitation.	Excess of Precipitation over Evaporation.	Precipitation.	Total Evaporation.
	Inches.	Inches.	Inches.	Inches.
April 13—May 1	1·140		0·05	1·190
May 1—May 31		3·696	5·44	1·744
May 31—June 30	1·380		3·52	4·900
June 30—July 31	2·376		2·11	4·486
July 31—August 31		5·876	9·40	3·524
August 31—September 30	2·160		0·99	3·150
September 30—October 31		0·192	1·31	1·118
October 31—November 30	0·192		0·26	0·452
Totals	7·248	9·764	23·08	20·564

EVAPORATION Observations, 1899.—McCaskill Lake—Station No. 2—Pan in water.
Sec. 25, Tp. 16, R. 2, W. 5th M.

Interval.	Excess of Evaporation over Precipitation.	Excess of Precipitation over Evaporation.	Precipitation.	Total Evaporation.
	Inches.	Inches.	Inches.	Inches.
May 10—May 29		5·650	5·733	0·083
May 29—June 30	1·750		1·185	2·935
June 30—July 28	6·450		2·080	8·530
July 28—August 29	1·750		7·880	9·630
August 29—September 30	2·750		1·990	4·740
September 30—October 29	1·100		0·350	1·450
Totals	13·800	5·650	19·218	27·368

EVAPORATION Observations, 1899.—Nanton Lake—Station No. 2—Pan in water.
Sec. 5, Tp. 17, R. 28 W. 4th M.

Interval.	Excess of Evaporation over Precipitation.	Excess of Precipitation over Evaporation.	Precipitation.	Total Evaporation.
	Inches.	Inches.	Inches.	Inches.
May 5—May 30		1·700	5·332	3·632
May 30—June 29	7·450		2·060	9·510
June 29—July 31	6·000		2·700	8·700
July 31—August 30		1·650	7·880	6·230
August 30—September 28	1·800		1·380	3·180
September 28—October 28	1·450		1·560	3·010
Totals	16·700	5·350	20·912	34·262

EVAPORATION Observations, 1899.—Mosquito Creek—Station No. 2—Pan in ground. Sec. 29, Tp. 16, R. 28 W. 4th M.

Interval.	Excess of Evaporation over Precipitation.	Excess of Precipitation over Evaporation.	Precipitation.	Total Evaporation.
	Inches.	Inches.	Inches.	Inches.
May 5—May 31.		2·532	5·78	3·248
May 31—June 30	3·564		1·96	5·524
June 30—July 31	3·120		3·07	6·190
July 31—August 31		3·504	7·90	4·396
August 31—September 30	1·644		1·39	3·034
September 30—October 31	0·180		1·56	1·740
Totals	8·508	6·036	21·66	24·132

EVAPORATION Observations, 1900.—Calgary—Station No. 1—Pan in ground.

Interval.	Excess of Evaporation over Precipitation.	Excess of Precipitation over Evaporation.	Precipitation.	Total Evaporation.
	Inches.	Inches.	Inches.	Inches.
April 1—April 30	0·372		2·04	2·412
April 30—May 31	2·724		1·32	4·044
May 31—June 30	1·032		3·56	4·592
June 30—July 31	2·424		2·02	4·444
July 31—August 31	2·400		1·29	3·690
August 31—September 30		3·024	3·99	0·966
September 30—October 31	0·108		0·40	0·508
October 31—November 14	0·504		0·00	0·504
Totals	9·564	3·024	14·62	21·160

WATER SUPPLY.

The question of the quantity and permanency of the surface water supply must necessarily have a marked bearing upon the development by irrigation of any arid or semi-arid country. Fortunately, the semi-arid portion of the Territories has, as a whole, been favoured with a very fair supply of water, and the information given below is intended to illustrate in as graphic a manner as possible both the volume and permanency of the supply.

The methods adopted in determining the volume of the water supply are explained at some length in the section of this report dealing with the General Irrigation Surveys, and it will therefore suffice to say here that the object aimed at is to determine by careful scientific measurements the quantity of water flowing at all seasons of the year in the different rivers and creeks, which can be drawn upon to supply water for irrigation, and to base our calculations of the amount available from such sources upon these measurements.

Having determined the quantity of water available for irrigation, we would naturally be at a loss to state the number of acres that such quantity of water would irrigate, unless we first had some idea of the quantity required to irrigate one acre. This ratio between the acreage to be irrigated and the quantity of water required to irrigate it is called the 'Duty of Water,' and is fixed by the regulations, as is explained in the section of this report dealing with the law relating to the use of water for irrigation. At present the duty is fixed at one cubic foot of water per second, flowing continuously during the irrigating season, for each one hundred and fifty acres of land to be irrigated.

The information so far obtained by our irrigation surveys regarding the available water supply is condensed in the following statement, the quantity in all cases being expressed in cubic feet per second, or second feet as usually designated.

STATEMENT of Water available for Irrigation from certain Streams and of Quantity recorded and still available from such Streams.

Name of Stream.	Low Water.			High Water.			Flood Stage.		
	Flow at Low Water.	Quantity Recorded.	Quantity Still Available.	Flow at High Water.	Quantity Recorded.	Quantity Still Available.	Flood Discharge.	Quantity Recorded.	Quantity Still Available.
	S. F.	S. F.	S. F.	S. F.	S. F.	S. F.	S. F.	S. F.	S. F.
Battle Creek	6.100	5.599	0.501	72.55	12.665	59.885	218.59	12.665	205.925
Bear Creek	13.09	2.044	11.046	54.00	2.044	51.956	159.00	2.044	156.956
Beaver Creek (tributary of Oldman River)	4.77	2.666	2.004	16.00	2.666	13.334	25.00	2.666	22.334
Beaverdam Creek	7.94	5.070	2.870	48.00	5.070	42.930	69.00	5.070	63.930
Belanger Creek	7.29	2.200	5.090	25.51	2.200	23.310	355.05	2.260	352.850
Belly River	399.30	16.584	382.716	1445.00	16.584	1428.416	30656.00	16.584	30639.416
Big Hill Creek	1.70	0.6845	1.0155	61.00	0.6845	60.316		0.6845	
Boundary Creek		0.986			0.986			0.986	
Bow River	2779.57	2053.646	725.924	26224.00	6053.646	20170.354	41945.00	6053.646	35891.354
Bridge Creek (or 32 mile or Dirt)	1.200	1.200	0.00		1.200		92.000	1.200	90.800
Callum Creek		0.373			0.373			0.373	
Canyon Creek		0.533			0.533			0.533	
Carter Creek		0.599			0.599			0.599	
Coal (or Grand Valley) Creek		0.00			3.866			3.866	
Connelly Creek	1.15	1.000	0.15	8.00	1.000	7.00	20.00	1.000	19.00
Cottonwood Creek (tributary of Battle Creek)		2.666			2.666			2.666	
Coulee on Sec. 25, Tp. 8, Rg. 25, W. 4 M.		2.000			2.000			2.000	
Creek in Tp. 24, Rg. 2, W. 5 M. (tributary of Elbow River, on north side)		0.407			0.407			0.401	
Creek in Sec. 6, Tp. 24, R. 2, W. 5 M. (tributary of Elbow River on South side)		0.650			0.650			0.650	
Creek in Tp. 24, R. 4, W. 5 M. (tributary of Elbow River)	22.50	2.400	20.10		2.400			2.400	
Creek in Tp. 1, Rg. 25, W. 4 M.		1.275			1.275			1.275	
Dog pound Creek	2.40	0.800	1.60	153.00	0.800	152.20	432.00	0.800	431.200
Dry Timber Creek		2.053			2.053			2.053	
Elbow River	210.50	455.581	0.00	2113.00	667.581	1445.41	7368.00	667.581	6700.42
Etzikom Coulee		Total flow.	0.00		Total flow.	0.00		Total flow.	0.00
Fish Creek (Main Stream)	16.10	11.157	4.943	657.00	17.059	639.941	1205.00	17.059	1187.941
" " (North Fork)	1.86	1.300	0.56	28.41	2.966	25.444	108.00	2.966	105.034
" " (South Fork)	3.86	3.166	0.694		3.166			3.166	
Forty Mile Creek		0.030			0.030			0.030	
Hay Creek	2.00	2.000	0.00		3.700		232.00	3.700	228.300

STATEMENT of Water available for Irrigation from certain Streams and of Quantity recorded and still available from such Streams—*Con.*

Name of Stream.	Low Water.			High Water.			Flood Stage.		
	Flow at Low Water.	Quantity Recorded.	Quantity Still Available.	Flow at High Water.	Quantity Recorded.	Quantity Still Available.	Flood Discharge.	Quantity Recorded.	Quantity Still Available.
	S. F.	S. F.	S. F.	S. F.	S. F.	S. F.	S. F.	S. F.	S. F.
Heath Creek	3 86	0 666	3 194	21 00	0 666	23 334	37 00	0 666	36 334
Highwood River	109 05	104 905	4 145	1793 00	104 905	1688·095	23538 00	104 905	23433 095
Indian farm Creek		1 333		...	1 333			1 333	
Jackfish Creek	......	0 790	..		0 790			0 790	
Jumping pound Creek	24 60	307 760	0 00	133 30	307 760	0 00	7411 24	307 760	7103 48
Kuntz Creek	0 69	2 333	0 60	6 00	2 333	3 667	15 00	2 333	12 667
A lake in Tp. 1, Rg. 24, W. 4 M		1 036			1 036			1 036	
Lake No. 1, Tp. 21, Rg. 1, W. 5 M		0 547			0 547	...		0 547	
" Tp. 1, Rg. 26, W. 4 M		0 250			0 250			0 250	
Lee Creek	11 30	0 152	11 148	1136 00	6 342	1129 658	3136 00	6 342	3129 658
Little Bow River	0 00	0 893	0 00	326 00	0 893	325 108	993 00	0 893	992 108
Macabee Creek	1 66	2 520	0 00		4 026			4 026	
Mahnne Creek	1 00	0 370	0 630		0 370			0 370	
Maple Creek		3 300	..	310 00	3 850	306 15	1279 00	3 850	1275 15
Meadow Creek (tributary of Oldman River)	...	1 713			1 713			1 713	
" " (" Belly River		0 266			0 266			0 266	
Muddypound Creek	2 82	2 82	0 00	16 00	4 180	11 82	26 00	7 400	18 600
Middle Coulee "		Total flow.	0 00		Total flow.	0 00		Total flow.	0 000
Milk River	44 69	500 030	0 00	2658 20	1500 030	1158 17		1500 030	
Mill Creek		2 000	......		2 000			2 000	
Mosquito Creek	0 26	0 26	0 00	216 00	3 526	212 414	2105 00	3 526	2101 414
Nanton Creek	0 82	0 70	0 12	13 00	2 441	10 559	361 00	2 441	358 491
Nine mile Coulee		Total flow.	..		Total flow.			Total flow.	
Nose Creek	15 20						1996 00		
Oldman River	1078 00	1 200	1076 80	9201 30	1 200	9200 10	31990 00	1 200	31988 80
Piapot Creek	2 14	2 14	0 00	46 00	2 900	43 100	401 00	2 900	398 10
Pincher Creek	19 80	9 20	10 60	483 00	9 20	473 80	3714 00	9 20	3701 80
Pine Creek	0 00	0 00	......	27 00	0·00	27 00	..		
Pinepound Creek (or Spring Coulee)	.	Total flow.	...	..	Total flow.		.	Total flow.	
Pothole Creek	...	" "	...	....	" "		..	" "	.....
Ranche Creek	..	0 500		......	0 500			0 500	
Rolph Creek	2 30	1 600	0 700	23 00	1 600	21 400	52 00	1 600	50 400
Rosebud River	1 433	1 433	0 00	10 000	1·433	8 567	29 000	1 433	27 567

Sufficient water to fill reservoir.

Ross Creek, (Assa.)		0·030			0·030			0·30	
Ross Creek, (Alta.)	18·00	3·866	14·134	1583·00	3·866	1579·134	4711·00	3·866	4707·134
Rush Lake Creek		7·770			7·770			7·770	
Seven Persons Coulee	2·09	0·015	2·075		0·015		3870·00	0·015	3869·985
Sheep River	159·10	52·688	106·412	15457·00	52·688	15404·412	22230·00	52·688	22177·412
Skull Creek		9·300		20·0	9·500	10·500	46·00	9·500	36·500
Snake Creek		3·435			3·435			3·435	
South Fork River	303·35	3·466	299·884		3·466			3·466	
South Saskatchewan River		2·039			2·039			2·039	
St. Mary River	741·30	501·332	239·968	3003·00	1001·332	2001·668	21380·00	1001·332	20378·668
Stead Creek		4·000			4·000			4·000	
Sullivan Creek	5·06	0·866	4·194		0·866			0·866	
Swift Current Creek	29·93	2·12	27·81	131·00	2·12	128·[illegible]	1434·00	2·12	1431·88
A Spring Creek (tributary of south fork of Trout Creek)		0·300			0·300			0·300	
A Spring Creek in Tp. 24, Rg. 2, W. 5 M.		0·280			0·280			0·280	
" " Tp. 16, Rg. 29, W. 4.		1·086			1·086			1·086	
" " Tp. 22, Rg. 3, W. 5 M.		0·266			0·266			0·266	
" " Tp. 11, Rg. 29, W. 4 M.		0·926			0·926			0·926	
" " Tp. 27, Rg. 3, W. 5 M.		0·230			0·230			0·230	
" " Tp. 18, Rg. 29, W. 4 M.		3·200			3·200			3·200	
" " Tp. 9, Rg. 28, W. 4 M.		0·500			0·500			0·500	
" " Tp. 19, Rg. 22, W. 4 M.		0·666			0·666			0·666	
" " Tp. 19, Rg. 15, W. 3 M.		0·933			0·933			0·933	
" " Tp. 19, Rg. 15, W. 3 M.		0·400			0·400			0·400	
" " Tp. 22, Rg. 3, W. 5 M.		2·000			2·000			2·000	
" " Tp. 21, Rg. 3, W. 5 M.		0·533			0·533			0·533	
" " Tp. 6, Rg. 27, W. 3 M.		0·050			0·050			0·050	
" " Tp. 26, Rg. 2, W. 5 M. tributary of Beddington Creek.		0·666			0·666			0·666	
Todd Creek	4·25	2·433	1·817	46·00	3·766	42·234	101·00	3·766	97·234
Trout Creek	20·94	10·819	10·121	103·00	12·419	90·581	177·00	12·419	164·581
Waterton (or Kootenay River)	501·90	19·350	482·550	5465·00	19·350	5445·650	7854·00	19·350	7834·650
Willow Creek	25·80	3·35	22·45	1837·65	3·35	1834·30	1761·00	3·35	1757·65
A Spring Creek in Tp. 14, Rg. 1, W. 5 M.		0·793			0·793			0·793	
" " Tp. 20, Rg. 2, W. 5 M.		0·353			0·353			0·353	
" " Tp. 21, Rg. 3, W. 5 M.		1·650			1·650			1·650	
Gold Creek		6·000			6·000			6·000	
A Spring Creek in Tp. 12, Rg. 1, W. 5 M.		0·313			0·313			0·313	
" " Tp. 11, Rg. 1, W. 5 M.		0·240			0·240			0·240	
Big Plume Creek		0·666		128·00	0·666	127·334	349·00	0·666	348·334
A Creek in Tp. 7, Rg. 23, W. 3 M.		0·533			0·533			0·533	
" Tp. 19, Rg. 2, W. 5 M.		0·966			0·966			0·966	
Red Deer River	539·90		539·90	7203·00		7203·00	14429·00		14429·00
A Spring Creek in Tp. 14, Rg. 29, W. 4 M.		0·286			0·286			0·286	
" " Tp. 15, Rg. 29, W. 4 M.		0·253			0·253			0·253	
" " Tp. 15, Rg. 29, W. 4 M.		0·90			0·90			0·90	
" " Tp. 15, Rg. 29, W. 4 M.		0·10			0·10			0·10	
" " Tp. 15, Rg. 29, W. 4 M.		0·280			0·280			0·280	

STATEMENT of Water Available for Irrigation from Certain Streams and of Quantity Recorded and Still Available from Such Streams.

Name of Stream.	Low Water.			Low Water.			Flood Stage.		
	Flow at Low Water.	Quantity Recorded.	Quantity still Available.	Flow at High Water.	Quantity Recorded.	Quantity still Available.	Flood Discharge.	Quantity Recorded.	Quantity still Available.
	S. F.	S. F.	S. F.	S. F.	S. F.	S. F.	S. F.	S. F.	S. F.
A Spring Creek in Tp. 14, Rg. 29, W. 4 M.		0·273			0·273			0·273	
Miry Creek		1·166			1·166			1·166	
Beddington Creek	0·70		0·70	21·00		21·00			
Boxelder Creek				449·00		449·00	3661·00		3661·00
Bragg Creek	10·56		10·56						
Bullshead Creek	6·35		6·35				1880·00		1880·00
Cataract Creek	57·33		57·33						
Cow Creek	2·99		2·99	33·00		33·00	73·00		73·00
Fisher's Creek	15·71		15·71						
Frenchman Creek	23·22			655·00			1857·60		
Gap Creek							1515·00		1515·00
Little Red Deer River	30·10		30·10	1044·00		1044·00	2247·00		2247·00
McKay Creek				624·00		624·00	1665·00		1665·00
Medicine Lodge Creek	2·82		2·82	16·00		16·00	26·00		26·00
Pekisko Creek	9·95		9·95						
Prairie Creek	22·07		22·07						
Stimson Creek	3·90		3·90	5153·00		5153·00	7131·00		7131·00
Ware Creek	5·80		5·80						
Total flow	7403·773			89758·92			264364·88		

It has already been stated that the area of the semi-arid region is 64,621,169 acres. It will therefore at once be seen that the total amount of water available for irrigation will only irrigate a small percentage of that area.

There are, of course, certain other small water supplies not included in the above statement, but speaking in general terms it may be stated that even under the most favourable circumstances of storage of the high water and flood discharges of the streams, and the most intelligent use of the water, we cannot hope to irrigate more than 15 per cent of the vast area included in the semi-arid region.

This statement will serve to illustrate the fact that for all time some 85 per cent of this area must be devoted to grazing, and indicates that the greatest development in the region will result from as wide a distribution as possible of the irrigated areas throughout the whole region.

IRRIGATION DEVELOPMENT

IRRIGATION DEVELOPMENT.

The irrigation development which has taken place in the Territories is probably illustrated in its most graphic form by the following schedule of the ditches constructed, with their length and the acreage irrigable therefrom. This schedule will also be of value as indicating the records which have so far been made against the sources from which water is diverted for irrigation purposes.

SCHEDULE of Canals and Ditches constructed and in operation in the North-west Territories, together with those which have been authorized to be constructed.

Name.	Source of Supply.	Length of Ditch in Miles.	Acreage to be Irrigated.
		Miles.	Acres.
Aird, Alexander	North fork of Sheep river	1·50	90
Aird, James	"	0·40	110
Anderson, G., jun	"	0·50	80
Anderson, G., sen	"	0·50	20
Austin & Mathewson	Sheep river	1·20	70
Alberta Ranche Co	Pincher creek	1·10	270
Armour, H	Qu'Appelle river	0·50	450
Anderson, W	Spring creek in Tp. 20—2—5	0·60	53
Banister, A. E	Bow river	1·87	160
Bell, Mary	North fork of Sheep river	0·90	100
Bell-Irving & Kerfoot	Coal creek	5·30	580
Blake & Miles	Tributary Oldman river	0·90	100
Botterell, E. H	Dogpound creek	1·00	80
Braniff, Daniel	Bear creek	1·50	200
Burn, H. St. G	Connelly creek	0·50	100
Bateman, Bateman & Harker	Lee creek	1·00	71
Burke, A. E	Spring creek, Tps. 11 12—1—5	2·00	83
Blake, George	" Tp. 14—29—4	0·60	41
Broderick, A. T	Highwood river	4·16	452
Binger & Kerr	Qu'Appelle river	0·25	344
Cochrane Ranche Co	Big Hill creek	1·50	68
Calgary Irrigation Co	Elbow river	81·00	45,000
Canadian Land & Ranche Co	Skull creek	2·50	930
" "	Bridge creek	1·50	120
" "	Rush lake	3·12	777
Card & Hammer	Lee creek	5·10	823
"	"	1·10	23
Cochrane Ranche Co	Belly river	3·10	200
Cook, H. F	Boundary creek	1·70	145
Cumberland, A	Piapot creek	0·30	50
Carey, E. E	North fork of Sheep river	0·80	107
Cyr, Cyr & Pelletier	Stead creek	1·50	600
Cross, A. E	Ranche & Dry Timber creeks	3·20	122
"	West branch Dry Timber creek	2·04	200
Cowan, R. W	Creek in Tp. 27—3—5	0·42	23
Canadian Northwest Irrigation Co	St. Mary river	90·00	500,000
Coughlin, C	Nanton creek	2·25	174
Comer, R. P	Big Plume creek	1·40	100
Carpenter, H. W	Creek in Tp. 14—29—4	0·60	43
Dixon, Brothers	Maple creek	1·22	55
Darling, A	Carter creek	0·57	40
Edgar, William	Fish creek	1·40	82
Ellis, J. H	Elbow river	0·85	110
Elton, C. W. S	Todd creek	0·60	50
Fauquier, H. H	Hay creek	1·10	50
Flint, Charles	Fish creek	1·50	120
Fisher, Joseph	North fork of Sheep river	1·75	375

SCHEDULE of Canals and Ditches, &c.—*Continued.*

Name.	Source of Supply.	Length of Ditch in Miles.	Acreage to be Irrigated.
		Miles.	Acres.
Fitz-Gerald, W. D	Fish creek	0·60	50
Findlay & McDougall	Highwood river	8·50	4,743
Fraser & McKinnon	North fork of Sheep river	1·00	315
Furman, John	Lake in Tp. 1—26—4	1·25	25
Farr, J. G	Skull creek	1·70	50
George Brothers	Beaver creek	3·00	400
Gardner, M	Tributary of Elbow river	2·30	360
George, Colin	Willow creek	2·50	175
Glen Estate	Fish creek	1·00	130
Glengarry Ranche Co	Trout creek	2·85	473
Godsal, F. W	Southfork river	0·80	280
Greeley, H. A	Maple creek	0·80	110
Gaff, J. A	Battle creek	2·60	860
Greig, George	Spring creek in Tp. 16—29—4	1·60	163
Gebo, S. W	Gold creek	1·25	197
Grant, J. A	Creek in Tp. 19—2—5	2·10	145
Herron, John, et al.	Pincher creek	3·00	975
Hull, W. R	Bow river	5·00	800
''	Fish creek	1·00	500
''	Nanton creek	1·20	105
Hunter Brothers & Edgar	Fish creek	2·20	216
Hunter Brothers	''	1·20	168
Hone, A	''	1·25	130
Hudson's Bay Co	Jackfish creek	0·40	80
Hammond, G. R	Hay creek	0·90	25
Houk, George	St. Mary river	0·75	88
Indian Department	Bow river	8·50	2,20[illegible]
Johnston, J. L	Rosebud river	1·50	215
Jones & Smart	Springs in Tp. 19—15—3	1·50	200
Johnson, E	Spring creek in Tp. 22—3—5	1·75	300
Jones & Webster	Miry creek	2·25	175
Kemmis, J. H. W. S	Todd creek	1·50	150
Law, John	''	0·50	90
Lineham, John	Macabee creek	1·70	252
''	Creep in Tp. 20—2—5	0·30	100
''	Macabee creek	4·03	226
Lott, H. S	Elbow river	1·30	300
''	Creek tributary of Elbow river	1·23	65
Lachance, P., et al.	Belly river	3·50	1,140
Lane, George & Co	Kuntz Creek	3·25	350
Leeds, Elliott & Co	Willow creek	3·25	240
Lees, W. R	Mill creek	0·70	191
Lloyd, Alfred	Piapot creek	0·30	100
Lyndon, C. A. & W. A	Trout creek	1·70	160
Little Bow Cattle Co	Mosquito creek	3·20	360
Lawson, H. C	Qu'Appelle river	0·50	320
Lidner, John	Battle creek	1·60	200
Mead, F. A	Todd creek	0·90	200
May, E. G	Elbow river	1·00	103
Marsh, Dixon, et al.	Belanger creek	6·00	330
Millar, Adams & King	North fork of Sheep river	1·10	165
McHugh, T. P	Spring in Tp. 19—22—4	0·50	100
McLaughlin, J. W	Highwood river	3·80	680
Maple Creek (Canada) Cattle Co	Cottonwood creek	1·00	405
Macleod, N	Southfork river	1·33	100
McDonald & Sherbourne	Sheep river	4·25	799
McNab, W. H. & J	Coulee in Tp. 8—25—4	1·50	300
McDermid, M	Spring creek in Tp. 14—1—5	1·25	119
McEwan, J. H	Spring creeks in Tp. 15—29—4	3·50	220
Moorhead, Violet E	Piapot creek	3·00	300
Middleton, H. S	Sullivan creek	1·10	130
McIntosh, C. E	Spring creek in Tp. 18—29—4	4·25	480
Marshall, H	Battle creek	1·50	280
McDougall, D.	Qu'Appelle river	0·50	130
Nelson, John	Oldman river	1·00	180

SCHEDULE of Canals and Ditches, &c.—*Concluded.*

Name.	Source of Supply.	Length of Ditch in Miles.	Acreage to be Irrigated.
		Miles.	Acres.
N.W.M. Police	Spring in Tp. 2—24—4	0·50	25
" "	Waterton river	2·00	120
New Walrond Ranche Co.	Meadow & Callum creeks	1·90	313
New Oxley (Canada) Ranche Co.	Waterton river	2·75	1,855
Ockley, J. W	Fish creek	0 75	110
Owens, John	Lake in Tp. 21—29—4	2 40	82
Payne, W	Mahmee creek	0 55	37
Peecock, F. W	Hay creek	1 00	255
Peecock & Peecock	"	0 50	125
Priddis, Charles	Fish creek	2·00	130
Patterson, J. D	"	1·60	116
Pilling R., sen	St. Mary river	1·20	67
"	Snake creek	3 00	191
Patterson, W	Spring in Tp. 22—3—5	.....	40
Pearse, Spencer	Creek in Tp. 7—23—3	0·25	80
Pollock, D. H	South fork of Swift Current creek	0 50	295
Quail, W. H	South fork of Trout creek	1·80	30
Quirk, John	North fork of Sheep river	2·75	300
Quail, W. H	Muddypound creek	4 25	483
Ricardo & Bevan	Bow river	3·15	250
Russell, G. F	Pothole creek	1 50	80
Ross & McLean	Ross creek	2 75	580
Rowland, A. W	Sheep river	4 75	630
Robertson, T. W	Highwood river	4 30	955
Swan, Mary Cowper	Sheep river	4·00	685
Short, J. W	Highwood river	2·00	240
Skrine, W. C	Mosquito creek	0 60	20
Sharples, Charles	Trout creek	1·00	650
Shaw, Helen	Fish creek	0 25	18
Shea & Madden	Beaverdam creek	2·25	249
Springbank Irrigation District	Jumpingpoundcreek	10 00	30,000
Sheepy, Joseph	A swamp in Tp. 22—1—5	0 55	59
Spalding, C	Highwood river	1 42	315
Sexsmith, J. L.	Little Bow river	2·75	134
Stewart, W. R	Spring creek in Tp. 11—29—4	0 50	139
Stevenson, J. & W.	Trout creek	2·40	500
Stevenson, R. & A.	Muddypound creek	4·00	627
Smith & Tee.	Highwood river	2·30	263
Turner, Robert.	North fork of Sheep river	1·50	145
Thibaudeau, J. B	Indian farm creek.	1.10	200
Vaughn, W. R.	Rolph creek and a lake	1·55	345
Waite, J. T	North fork of Sheep river	1 00	120
Walker, B. G	Elbow river	1 00	175
Wallace, A. T	Piapot creek	1·00	40
Wallace, R. A.	Highwood river	10 00	2,186
Warren, J. C	Creek in Tp. 21—3—5	1 00	80
Walsh, R., sen. & jun	Beaverdam creek	2·75	258
Woolf, J. W	Snake creek.	1·75	216
Wurz, J. D	Wallace creek	.....	60
West, J. N	Meadow and Canyon creeks	1·75	120
Young, G. T	Fish creek	1 25	310

The facts contained in the foregoing schedule regarding irrigation development may for more ready reference be expressed in the following condensed form:—

Number of canals and ditches constructed	163
Length of canals and ditches constructed	474.51
Number of acres susceptible of irrigation from constructed canals and ditches	623,362
Approximate increased value of land susceptible of irrigation	$1,850,000

It will be seen from the general schedule given above that the larger number of constructed ditches are small undertakings designed for the irrigation of individual holdings of small area. Several of the larger canals or ditches are, however, designed to supply water for the irrigation of an extensive acreage, and are deserving of special mention.

CALGARY IRRIGATION COMPANY.

This company is the pioneer irrigation company in the Territories, having commenced the construction of their works in 1893. Their main canal heads in the Elbow river at a point about twenty-five miles west of Calgary, and their scheme embraces the irrigation of an area of some 45,000 acres situated west and south-west of Calgary. The company having constructed some eighty-one miles of main and distributing ditches, and for the past few years have been in a position to supply water for the irrigation of considerable areas. Unfortunately for the success of this company, the completion of their works was followed by a cycle of wet seasons during which it has been little used for irrigation, and in addition a large proportion of the land susceptible of irrigation from their canal is situated on the Sarcee Indian reserve, and is at present unavailable for settlement or development by irrigation. The areas which have been supplied with water for irrigation by this company have yielded good returns, and clearly demonstrated that during dry years the company will be called upon to supply water for irrigation at remunerative rates, and as their works have been carefully located and permanently constructed, there is no doubt that the supply of water by this company must ultimately play a very important part in the development of the district embraced in their scheme.

THE SPRINGBANK IRRIGATION CANAL.

The Springbank canal is the only one which has so far been undertaken under the provisions of the Irrigation District Ordinance, the provisions of which are explained further on in these pages. The canal takes water from Jumping Pound creek, and is designed to supply water for the irrigation of some 30,000 acres of land in the Jumping Pound and Springbank districts, lying west of Calgary and between the Bow and Elbow rivers. The main canal, when completed, will be some 35·5 miles in length, but so far only some 10 miles of the canal and the necessary headworks have been completed, and no water has as yet been used in the district for irrigation. The completion of this scheme has been delayed owing to disagreements among the residents of the district as to the necessity for irrigation, and from the time of the organization of the district there has been a minority of the residents who have strongly opposed the construction of the canal. Their arguments have been considerably strengthened by the wet seasons experienced during the past few years, but the dry years which are now about due will doubtless have a marked influence in pushing the canal to completion, and in encouraging the residents of the district in irrigating their land.

CANADIAN NORTH-WEST IRRIGATION COMPANY.

South and south-east of Lethbridge there is a section of country which from the standpoint of soil and temperature offered many attractions to the settler, but which, owing to insufficient rainfall, was up to three years ago in its virgin state, and occupied only by a few small roving bands of cattle and horses.

During the year 1895 the possibility of providing water for the irrigation of this favourable section of country was proved by the location in connection with the General Irrigation Surveys, as is described further on, of the St. Mary's Irrigation canal, designed to divert water from the St. Mary river for the irrigation of the district referred to. The feasibility of the scheme having been proved by the government surveys, a

company was subsequently formed under the above name, and representing English capital, to develop the undertaking, and the work accomplished by them marks the first step in successful introduction of irrigation on a large scale in our semi-arid region.

The area embraced in this company's original undertaking was 500,000 acres, but they have lately extended their scheme to include a further tract of some 500,000 acres and purpose augmenting the supply of water obtained from the St. Mary river for irrigation of the original tract by diverting water from the Belly and Milk rivers for the irrigation of the additional tract.

The canals so far constructed by this company comprise a total length of about 85 miles, and in addition they utilize about 20 miles of the channels of natural water courses intersecting these lands for the carriage of water for irrigation. The expenditure by this company to date amounts to some $400,000, and with the completion of the proposed extension of their system their ultimate investment will reach at least a million dollars.

The settlement and development which has resulted from the operations of this company are of a most gratifying nature, and are a very marked object lesson regarding the ultimate effect which the construction of large irrigation undertakings will have upon the development of our semi-arid region. When this company began operations the large area embraced in their scheme was practically unoccupied and devoted entirely to the grazing of a few isolated bunches of cattle and sheep. To-day there are three thriving villages situated in the tract, each containing from five to seven hundred inhabitants; the tract is traversed by a narrow gauge railway, and this season some six thousand acres of very fine crops of grain and vegetables were produced. At Raymond, one of the villages mentioned, a mill and elevator have been built, and a beet sugar factory involving an expenditure of half a million dollars is in course of erection. At least fifteen thousand head of cattle and thirty thousand sheep have been brought into the district since the canals constructed by this company provided adequate water for stock-watering purposes, and the general development of that part of the Territories has kept pace with the parts in the humid districts most favoured by the large number of immigrants now settling in the Territories.

R. A. WALLACE DITCH.

This ditch, which takes water from High river, about three miles above the village of that name, is one of the larger ditches built by private individuals for irrigation of their own land only. The ditch is about ten miles in length, and provides water for the irrigation of 2,185 acres of land, the larger portion of which has so far been devoted to raising timothy which is baled and shipped to the British Columbia market. This ditch, which was one of the first constructed in the district, has transformed a large area, which was up to the time of its construction devoted solely to grazing purposes, into one of the finest farms of the west, and has provided a marked object lesson regarding the successful production of the finest hay by means of irrigation, and the possibility of marketing such hay at a profit.

FINDLAY AND McDOUGALL DITCH.

This ditch is also situated in the High River district, taking water from that stream, and is designed to irrigate some 2,600 acres of land, the main ditch being about nine and a half miles in length.

The scheme was originally undertaken by several residents of the district as a partnership ditch, but has now fallen into the hands of Messrs. Findlay & McDougall, two of the original promotors. The completion of the ditch has been delayed by troubles among the original owners, but the scheme is now in shape to supply water next year for irrigation, and as the land under the ditch is of first-class quality, its cultivation by means of irrigation is sure to yield handsome returns.

T. W. ROBERTSON DITCH.

This scheme was originally undertaken for the irrigation of a comparatively small area lying immediately east of the village of High River, but has been enlarged and extended until the main ditch comprises a length of about ten miles, and furnishes water for some 1,265 acres. The water is diverted from High river, immediately west of the village, and as the main ditch just south of the village passes within a few feet of the head of one of the channels of the Little Bow river, it is utilized, under arrangement with the owner, by the Territorial government to divert fifty cubic feet of water per second from the High river into the Little Bow river, so as to keep the latter stream running during dry periods, and thus afford water for the large number of stock on the range adjoining the valley of the Little Bow.

The area of land embraced in Mr. Robertson's irrigation project promises a bountiful return from the application of water, and in the course of a year or two should constitute one of the finest farms in that district.

NEW OXLEY RANCH COMPANY'S DITCH.

One of the largest and most complete of the irrigation systems constructed by different ranche companies to provide the large quantity of hay and oats needed in connection with their operations is that built by the New Oxley Ranche Company, taking water from the Kootenay river, and designed to supply water through some six miles of ditch for the irrigation of 1,850 acres of land situated between the Kootenay and Belly rivers at Standoff. Very bountiful crops of hay and oats have been raised on land under this ditch, and its operation has proved that a ranch company owning an irrigation ditch supplying water to suitable land can during each season raise sufficient fodder to enable them to feed calves and weak stock during bad winter weather.

W. R. HULL DITCHES.

These ditches, two in number, head respectively in Fish creek and the Bow river, and supply water for the irrigation of 1,300 acres of choice land situated between these streams. This area comprises part of what was originally a government farm, operated in connection with the Indian Department in the Territories, and is situated about eight miles south of Calgary.

The ditches put in by Mr. Hull were among the first to supply water for irrigation in that district, and the land under the ditches produced most bountiful crops of grain, timothy, bromus and vegetables during the dry seasons which followed the completion of these ditches. The irrigation of this farm, and the results therefrom for several years formed an object lesson as to the possibility of producing good crops by irrigation in that district, and did much to encourage the extension of irrigation works in that part of Alberta.

There are many others of the smaller irrigation schemes scheduled above which are worthy of special mention, but the information given regarding their location, length and areas irrigable therefrom will serve to indicate the wide distribution of the constructed irrigation works throughout the semi-arid region, and the important part which they are taking in the development of the country.

At the present time the construction of several extensive irrigation canals and a large number of smaller individual systems is contemplated, and there is little doubt that if the next five years prove dry, as seems highly probable, the mileage of constructed canals and ditches, and the acres of land irrigable therefrom will show a very marked increase.

Our experience with regard to irrigation development has been and will continue to be that of all semi-arid countries, and must of necessity show marked enlargement followed by periods of practical stagnation dependent upon the 'wetness' or 'dryness'

of the seasons. It is true that a considerable number of the residents of our semi-arid district are not misled by the recurring cycles of wet years, and realize that during the dry years which are sure to follow, only by irrigation can they hope to produce crops of any kind, but we have a large number of residents who under the influence of the results of one or two wet seasons, seem to have forgotten the disastrous results of their efforts to farm during previous years.

There is also the class who ask why it is necessary or desirable to expend large sums of money in constructing irrigation works to make agriculture successful in the semi-arid region, while there are such vast areas of unoccupied land in the humid portions of the Territories where all kinds of crops can be raised without irrigation.

All these influences have had, and doubtless will continue to have their effect on our irrigation development, but they are based on an entirely erroneous conception of the facts. In the first place it should be noted that the semi-aridity of the large portion of the Territories under consideration is not a matter of conjecture, but is susceptible of definite proof from the meteorological records covering the past eighteen years, and consideration of these records as given in this report should convince the most sceptical of the fact that during the majority of years the semi-arid region is not favoured with a sufficient rainfall to permit of crops being raised without irrigation. That being admitted, the wisdom of constructing works to provide water for irrigation during these dry seasons will surely be conceded, particularly if it is realized that during such dry seasons much more bountiful crops can be raised on irrigated lands than are produced on these lands or any others in the semi-arid region during wet seasons.

The answer to those who claim that it is unwise to expend large sums on irrigation works in the semi-arid region so long as free homesteads and cheap land are obtainable in the more humid portion of the Territories, is contained in the statement that the semi-arid region, comprising as it does a vast area of some 64,000,000 acres, contains the portion of the country best suited to ranching and dairy farming, and that it is principally as an incident connected with development along those lines, and not for grain raising solely, the irrigation undertakings are advocated.

The semi-arid portion of the country is traversed from east to west by the main line of the Canadian Pacific Railway; contains many of the most thriving towns and the only city in the Territories; produces to-day at least 75 per cent of the cattle and sheep exported from the Territories, and only needs increased area under irrigation to produce not only the large quantity of fodder and coarse grains required by our rapidly increasing stock industry, but a very considerable part of the dairy produce of the west.

It is admitted that the semi-arid region does not offer the same inducements as the more northern or eastern portions of the Territories to the incoming immigrant who desires to engage in grain or mixed farming, but to those who desire to go in for ranching or dairy farming the unlimited range for grazing, the absence of flies, the milder climate, and the certainty of producing each and every year by means of irrigation a bountiful crop of grain, hay and vegetables, should be influenced by the advantages offered by many sections of the semi-arid portion of the Territories.

RESULTS FROM IRRIGATION.

The actual application of water for irrigating growing crops has so far been almost entirely confined to lands situated in the valleys, from which water is taken for the smaller irrigation systems, and we have as yet no results from the irrigation of the higher or bench lands from larger irrigation undertakings. In discussing results we have also to include the past three years, which have constituted one of our marked wet cycles, and during which little water has been used for irrigation.

In presenting the information obtained regarding results, an effort has been made to condense the results in schedule form, it being thought that facts so condensed would provide the most graphic illustration of existing conditions.

BULLETIN No. 1.—Information from Irrigators, 1895.

Name.	Location of Lands. Tp.	Rg.	Mer.	Average Under Crop.	Description of Crop.	Number of Irrigations.	General Remarks.
Ricard & Bevan	22	29	4	30	Wheat and oats	2	Crops in too late. Ditches not in order and considerable hay not cut owing to weather, hence poor result.
Banister, A. E.	22	23	4	150	Native grasses	...	Irrigated continuously. Hay not cut, abundance of green grass. Grass left to seed ground.
Fisher, Joseph	21	3	5	301	Native grasses and vegetables.		Irrigated as required. Fifty acres not cut. Crops more than doubled by irrigation.
Lott, H. S.	24	2	5	20¾	Oats and timothy	..	Irrigated constantly. Hay cut on land that yielded none before irrigation.
Furman, J.	1	26	4	16	Timothy and vegetables	3	Land irrigated produced double the quantity of hay from land not irrigated.
Gardner, M.	21	4	5	50	No details	....	Believe irrigation will keep off frost. Land should be watered late in the fall, and grain not before blue tint is on, or it will weaken.
Wallace, R. A.	19	28	4	...	Wheat, native grasses and vegetables	1	Acreage of native grasses not known. Except on grass, plenty of natural moisture for good growth since May 21.
Hull, W. R.	22	1	5	147	Wheat, barley, oats, rye, timothy and bromus, native grasses and vegetables.	2	Would recommend that bromus be sown separately, not mixed with other grasses.
Glennie, W. G.	10	24	3	25	Oats, native grasses and vegetables.	1	Little irrigation needed owing to wet season. Potatoes below average.
Quirk, John	21	4	5	208	Rye and native grasses	.	Irrigated continuously. Believe in irrigating in fall, as land is moist as soon as frost leaves in spring.
Cochrane Ranche Co. & N. W. M. Police.	6	25	4	732	Oats and rye mixed, timothy, native grasses and vegetables.	2	
Anderson, G., sr.	21	3	5	20	Native grasses	...	Irrigated continuously. Cold weather and frost retarded growth.
Anderson, G., jr.	21	3	5	70	Oats, native grasses and vegetables.	....	Irrigated continuously. Potatoes did not do well. Hay fair. Frost retarded growth.
Jackson, F. A.	21	3	5	50	Native grasses	2	Water not distributed to best advantage. Creek often runs dry.
Aird, Alex.	20	4	5	40	Oats, rye and native grasses	2	Irrigation makes a considerable improvement after first year.
Edgar, William	22	3	5	9	Wheat and timothy	...	Fall irrigation a benefit. Spring freshets are good owing to manure from side hills.
Elliott, W. B.	26	4	5	60	Wheat, barley, oats, rye, native grasses and vegetables.	2	Cut very little hay, season has been too cold.
Pearce, William	24	1	5	10	Wheat, barley, oats, rye, timothy, alfalfa, peas and vegetables.	2	Extreme frost in May greatly injured barley and oats. Alfalfa and timothy seeded this year, no crop. Vegetables fair. Garden vegetables excellent. Grain was too small when irrigated and cold water checked growth. Had water been available at time of seeding results would have been better. Ditch and works not completed till May.

Flint, C.	22	3	5	26	Wheat, barley, native grasses and vegetables	2	No crop but hay in ten year.
Hooper, R. E.	24	3	5	26	Oats, native grasses, vegetables	4	Green grain averaged three to four tons per acre. Vegetables frozen.
Aird, James	21	3	5	80	Oats, rye, timothy, alfalfa and native grasses	4	Timothy and green oats excellent. First year of irrigation.
Moseley, W. R.	22	2	5	12	Wheat, oats and native grasses	2	Too much rain spoiled grass.
Newson, A. C.	21	2	5	100	Native grasses	..	No record kept.
Short, C. C.	18	29	4	8	Oats	2	Irrigation gave twenty bushels more grain per acre.
Wells, W. C.	26	6	5	100	Oats, rye, native grasses, vegetables	2	Land unfenced, crop small owing to cattle feeding.
Turner, Robert	21	3	5	60	Native grasses	2	
Newbolt, W. R.	21	28	4	20	Oats	1	Season too wet. Land not irrigated had as good crops.
Calgary Hydraulic Co.	24	1	5	140	Wheat and oats	2	Cut green. Grain promised well but did not mature owing to weather.
Walker, Jos.	24	1	5	31	Wheat, barley, oats	1	Water not on soon enough to start grain. Weather delayed ripening.
Lane & Co., Geo.	13	29	4	81	Native grasses, vegetables	8	Irrigated grass grew to renew that eaten down.
Vandin, E. H. O.	24	4	5	38	Wheat, barley, oats, alfalfa, bromus	2	Bad year for irrigation. Too cold in spring to put water on. Cannot grow crops to ripen, but irrigation is what is required for green feed.
Canadian Land & Ranche Co.	13	19	3	200	Native grasses	1	No remarks.
	12	23	3	800	Native grasses	1	Only cut small quantity. Most of grass left for winter feed.
Ellis, J. H.	24	4	5	25	Oats, native grasses	20	Slough grass grew very well but upland grass only slightly better. First year of irrigation.
Fraser & McKinnon	21	2	5	300	Native grasses	4	About 200 acres very light on account of being first season of irrigation.
May, E. G.	24	2	5	....	....	..	No details furnished.
Howe, Samuel	19	3	5	121	Wheat, oats, rye, native grasses, vegetables	3	No details furnished.
Elton, E. A.	8	1	5	73½	Wheat, barley, oats, rye, timothy, bromus, native grasses, vegetables	4	Timothy irrigated continuously. Grain by seepage from hay meadow. Oats 43 lbs per bushel. Wheat cut green.
Waite, J. T.	20	4	5	80	Native grasses	....	Portion of acreage only poorly irrigated. Good results where properly irrigated.
Bell, George	21	4	5	60	Native grasses	3	Only 40 acres cut. Results fairly good considering quality of soil.
Braniff, D.	11	23	3	160	Wheat, oats, barley, native grasses, vegetables	3	Vegetables of all kinds in abundance. Alkali bothers grain after hot dry weather.
Cardston Mormon Colony	3	25	4	....	Grain, native grasses, vegetables	2	No precise records kept. Crops are doubled when irrigated.
Stuart, W. W.	24	1	5	15½	Wheat, oats, alfalfa	1	Have no doubt could ripen grain two years out of three. As fodder is of more value, ripening is immaterial.
Ockley, J. W.	22	3	5	95	Wheat, barley, oats, timothy, bromus, native gasses.	1	Season very unfavourable on account of cold. Irrigation of great advantage.
Skrine, W. C.	16	1	5	74	Oats and native grasses	1	Care must be taken not to over irrigate this kind of soil (black loam).

BULLETIN No. 2. Information from Irrigators, 1896.

Name.	Location of Lands. Tp.	Rg.	Mer	Acreage Under Crop.	Description of Crop.	Number of Irrigations.	General Remarks.
Anderson, G., jr.	21	3	5	70	Oats and native grasses	2	Part of meadow not cut owing to snow storm. Crop was not heavy.
" sr.	21	3	5	15	Native grasses	2	Crop good, but laid by snow.
Aird, Alex	20	4	5	40	"	2	
Bell, George	21	3	5	10	"	1	No hay could be grown without irrigation. Meadow should be irrigated in early spring.
Broderick, Janie	18	28	4	30	Grain and vegetables	1	First time for five years I have had a garden. Irrigated oats stood nearly five feet high and those not irrigated did not grow at all. Owing to scarcity of lumber, was late getting water on land.
Blake & Miles	9	1	5	21	Oats, timothy and vegetables	2	Timothy poor (running out). Vegetables medium. Ditches not completed and crop not so good as it might be.
Bronard, S.	8	25	4	30	Wheat, oats and native grasses	2	Wheat an uneven crop. Part of oats cut green. Result not so satisfactory as it would be if ditch was more satisfactorily located.
Braniff, D.	11	23	3	230	Wheat, oats, native grasses and vegetables	2	Creek was low when water was most wanted. Good plan to irrigate in spring and fall when water is scarce in summer. Irrigation banishes gophers.
Cook, H. F.	1	20	4	35	Oats	. . .	Too cold for grain or vegetables to ripen. Sufficient rain and irrigation not necessary.
Cochrane Ranche Co.	5	26	4	170	Oats, native grasses and vegetables	2	Early part of season cold and unfavourable. Large part of meadows watered, not good enough to cut.
Critchley, H. D.	. .	. .	. .	20	Oats and vegetables	5	Oats cut green. Vegetables, very fair crop. Irrigate in fall and before spring sowing if possible. Not advisable to irrigate very young grain. Irrigate on dull days or at night.
Cardston Mormon Colony.	3	25	4	. . . .		2	No records kept. Yield doubled by irrigation. Variety of garden crops. Works not completed for irrigating grain lands. Verdict in favour of irrigation.
Calgary Irrigation Co.	24	3	5	140	Native grasses	Several	Lands unfenced, consequently best results not obtained, as hay was destroyed by cattle. Harvest greatly interrupted by broken weather.
Canadian Land and Ranche Co.	12	22	3	150	"	. . .	Irrigated continuously from May 1 to June 15.
" "	13	19	3	80	"		" " "
Critchley, O. A.	24	2	5	75	Wheat and oats	1	Small portion of crop not reached by the water was completely burned up and yielded nothing.
Claustre, J.	10	21	3	20	Native grasses	.	Found water too cold last year. Intend to make a reservoir to hold water so that the sun may warm it next season.

Banister, A. E.	22	28	4	50	Native grasses and vegetables.	3	After cutting, pasture proved good feed for fattening off steers at end of September.
Dixon Brothers	11	26	3	3	Oats.		Irrigated at intervals. Cut green and will not be threshed. If allowed to ripen would yield about eighty bushels to the acre.
Fowling, Annie.	22	3	5	9	"	2	First year of irrigation. Ditch not completed in time to get water where most needed.
Elliott, W. B.	26	4	5	50	Wheat, barley, oats, rye, native grasses and vegetables.	Several	Small vegetables first sown failed on account of frost and worm. Potatoes crippled by frost.
Edgar, William.	22	3	5	125	Oats, timothy and native grasses	1	Timothy sown on grass in 1894, crop now in first class condition. Recommends that timothy be sown in this way.
Elton, C. W. S.	8	1	5	28	Oats and native grasses.	2	Oats yielded forty bushels per acre, weighing over forty pounds per bushel. Green feed three to four feet high. Season so excessively dry much of the grain did not germinate until after irrigation. Would have irrigated sooner but ditch was not completed in time.
Fauquier, H. H.	10	25	3	25	Wheat, barley, oats and vegetables.	1	Wheat and barley not threshed. All vegetables were very good. Rain fell in spring and latter part of summer, which made one irrigation sufficient.
Fisher, Joseph	21	3	5	80	Native grasses	2	Water supply insufficient. 100 acres lying low, moistened by water produced best hay.
Furman, John	1	26	1	31	Oats and timothy.		Irrigated from April 15 to middle of June. Country no use without irrigation. Oats too heavy. Timothy, two to two and a half tons to the acre.
Gunn, W. M.	9	2	5	28	Oats and vegetables	1	Grain grew six and a half feet high, a little too rank for threshing, but fine for feed.
Gardner, M.	24	4	5	20	Oats and timothy.	2	Would have had only half a crop of oat-hay without irrigation, and no timothy. Crop is hardly a fair estimate, as was delayed cutting irrigated hay until after first snow and frost came.
Genge, Colin.	9	26	4	6	Native grasses	3	Had more from the six acres which were irrigated than from twenty-nine acres not irrigated, though did not get water on the land until late in June.
High River Horse Ranche Co.	13	29	4	20	Wheat	1	Cut green, result satisfactory. First time water has been applied. System of laterals not completed.
Hull, W. R.	22	1	5	325	Wheat, barley, oats, timothy, bromus mixed, bromus, native grasses and vegetables.	2	Good results. Vegetables, first class crop. Also had about 100 acres under grain, principally oats and wheat, which was cut for green feed and yielded 375 tons of feed.
Fraser & McKinnon.	21	2	5	300	Native grasses.	2	Water should have been turned on a month earlier, but feared weather was too cold. Have come to the conclusion that land with gravel subsoil cannot be hurt by early watering.
Jackson, F. A.	21	3	5	50	"		Irrigated whenever sufficient water in creek. Had hay elsewhere, so only cut a portion of irrigated meadow.
Jones & Smart.	19	15	3	150	Oats, native grasses and vegetables.	4	Have not a sufficient supply of water to expect good results on grass lands for a number of years.
Glengarry Ranche Co.	12	29	1	135	Wheat, oats, barley, rye and vegetables.	3	Grain was sown on breaking about end of May; promised to be heavy crop, but severe snow-storm early in September flattened it so that it did not recover.
Lott, H. S.	21	2	5	113	Oats, timothy, native grasses and vegetables.		Irrigations frequent from May 15 to August 1. Vegetables good. Grain crop irrigated. Warm weather in February drew frost from the ground.

BULLETIN No. 2.—Information from Irrigators, 1896—*Continued.*

Name.	Location of Lands. Tp.	Rg.	Mer.	Acreage Under Crop.	Description of Crop.	Number of Irrigations.	General Remarks.
Lane & Co., Geo.	11	29	4	100	Native grasses	Several	Hay extra good quality. Third year of irrigation, and think there is improvement.
Lachance, P.	8	25	4	60	Wheat, oats, native grasses and vegetables	2	Land under wheat irrigated twice, other lands once. Potatoes were irrigated previous year. Results good.
Leeds, Elliott & Co.	12	28	4	25	Wheat, barley, oats, rye, bromus, native grasses, vegetables.	.....	Irrigated from July 1 to August 1. Wheat, barley, oats and rye not threshed. Bromus and native grasses left to seed down. Ice carried away flumes in spring making irrigation late. What was watered was simply wonderful. Grain that was apparently burnt to the ground grew three feet in twenty days after being irrigated. Native grasses also showed similar growth. Had it not been for the water would have had nothing. Green feed went about three tons to the acre.
Lundquist, A. A.	1	26	4	25	Timothy, vegetables.	1	Had twenty tons of timothy and one ton of potatoes.
Lees, W. R.	6	1	5	22	Wheat, barley, oats, oats and timothy mixed.	1	Owing to bad weather during harvest a great deal of grain was lost. Oats weighed forty-six pounds to the bushel.
Moore, W.	10	25	3	90	Native grasses	2	Had seventy tons of hay. Creek dried up early in June, therefore could not make a success.
Moseley, W. R.	22	3	5	95	Oats, rye.	.....	Irrigated from June 22 to July 6. Irrigation is a great benefit.
McCarthy, C.	10	23	3	15	" potatoes.	2	Land is on a low bend of the creek and oats did not require irrigating. Left water on potatoes for twelve hours, or until land was well soaked.
Ockley, J. W.	22	3	5	95	Timothy, bromus, native grasses, vegetables	3	Bromus was mostly sown this season and made good stand for next year. The old stand of same was a good crop of three and a half tons to the acre. Timothy was sown June 10, cut August 31, yield two tons to the acre. A wonderful crop on first season.
Oxarart, M.	6	27	3	325	Oats, native grasses, vegetables		Irrigated at intervals. Had 800 bushels of oats and 350 tons of hay. Good crop of vegetables. Eighth year of irrigation.
Patterson, R.	8	25	4	25	"	1	Hay irrigated continuously. Had better results from grass land which was irrigated last year. The place has been used as a pasture for the last twelve years and no hay had ever been cut on it before.
Pearce, William	24	1	5	35	Barley, oats, oats and pease mixed, pease, timothy, bromus, vegetables.	4	Owing to inferior seed about half of oats went forty bushels to the acre, balance 80 bushels to the acre. Oats and pease made very high grade feed, both fairly matured. First ploughing being rough made irrigation difficult, and portions are so gravelly nothing will grow. Owing to inadequate threshing appliances twenty-five per cent of pease were not threshed and a large

							quantity were used as green pease for table use. Four acres of timothy seeded down previous year with barley equalled three tons to the acre, balance seeded with wheat, very thin, in places none. Benefits of irrigation last year were very marked.
Priddis, Charles	22	3	5	7	Native grasses	2	Had ten loads of hay. Will have a good deal more under water this year seeded down to timothy.
Samson & Macnaghten	24	2	5	76½	Wheat, barley, oats, native grasses	2	Good results.
Sheep Creek Irrigation Co.	20	1	5	1,200	" oats, native grasses	5	Only got about 100 acres properly irrigated, as were finishing main ditch, and did not complete it until July this year.
Sheldon, C. B.	11	25	3	25	Native grasses	3	Had ten tons of hay.
Turner, Robert	21	3	5	60	"	2	Had eighty "
Wallace, A. T.	10	24	3	17	Oats, native grasses, vegetables	1	Oats cut green. Hay, twenty tons. If irrigated in fall would have had better crop. Potatoes, good crop, not irrigated.
Waite, J. T.	20	4	5	40	"	Intervals.	Oats produced by soakage only. Irrigation not complete owing to want of laterals. Crop increased by one half by water applied.
Wallace, R. A.	10	28	4	300	Wheat, barley and oats mixed, bromus, native grasses, vegetables.	"	Spring cold making growth slow, especially of grass cut in 1895. Would prefer to irrigate in fall, so that water need not be put on till grass and grain are well up.
Young, G. T.	22	3	5	103½	Oats, native grasses	1	Irrigation has at least doubled the production of hay on this slough.
Warren, J. C.	21	3	5	40	Native grasses	1	Had fifty tons of hay. Did not get sufficient water owing to breach in dam.
Calgary Hydraulic Co.	24	1	5	100	Wheat, barley, oats	1	Good results.
Maunsell Brothers	9	26 7	4	5	Oats	2	Crops nearly killed by drought before we got water on the land.
McKay, A. S.	24	2	5	25	Wheat, oats, rye, vegetables	2	
McHugh, T. P.	22	19	4	50	Oats	4	Good results.
Newson, A. C.	21	3	5	120	Native grasses	......	Irrigated weekly from June 1 to July 20. Had 140 tons of hay.
Peecock, F. W.	11	25	3	50	"	2	Had sixty tons of hay. Not enough furrows to distribute water properly or result would have been better.
Quail, W. H.	12	29	4	30	Oats, alfalfa, bromus, vegetables	2	Think hay land can be irrigated with advantage in the fall and earlier in the spring than for a green crop.
Riley, D.	18	29	4	1	Vegetables	2	Two hundred bushels of potatoes. In former years the largest quantity of potatoes raised off the same ground without irrigation was fifty bushels.
Short, C. C.	18	29	4	50	Wheat, oats	2	Good results.
Shaw, S. W.	25	1	3	½	Garden stuff	As need.	Pease and turnips. Pease a splendid crop; all used green.
Walsh, R., sr.	22	3	5	16	Oats, native grasses	3	Did not give irrigation a fair trial, as water by irrigation was not badly needed, this being first crop.
McLaughlin, J. W.	19	29	4	91	Wheat, oats, rye, vegetables	....	Irrigated from May 9 to July 10. Good results. Should irrigate in fall on summer fallow. Part of wheat irrigated previous year went forty bushels to the acre.
Howe, Samuel	19	3	5	120	Rye, native grasses, vegetables	2	Without irrigation would not have been able to raise half the crop.
Quirk, John	21	4	5	220	" "	....	Irrigated all June and July. Good results. Without irrigation would not have been able to raise any hay on the land.
Ware, John	20	4	5	90	Wheat, oats, native grasses	2	Good results. Fifth year of irrigation.
Nelson, John	8	1	5	180	Oats, pease, native grasses, vegetables	2	"
N. W. M. Police	Stand-off			128	Native grasses, vegetables	2	Good crops. Grass also good when water put on.

BULLETIN No. 3.—Information from Irrigators, 1897.

Name.	Location of Lands. Tp.	Rg.	Mer.	Average under Crop.	Description of Crop.	Number of Irrigations.	General Remarks.
Turner, Robert	21	3	5	80	Native Grasses	2	No details given.
Fisher, Joseph	21	3	5	180	"	2	The meadow is improving and producing more hay of good quality. Is looked upon as a success.
Hull Brothers	22	1	5	327½	Wheat, barley, oats, timothy, bromus, native grasses, vegetables	2	Quality of timothy very fine, and excellent feed for horses. Prefer bromus for cattle, being softer and more leafy.
Leeds & Elliott	12	28	4	61	Wheat, oats, timothy, vegetables		Irrigated previous fall. Owing to flood field was under water three days and irrigation was not needed.
Caseley, A.	29	20	4	156	Wheat, oats, timothy, bromus, native grasses	3	Light yield of grain owing to late seeding. Timothy and bromus good.
Ellis, J. H.	21	4	5	10	Native grasses	10	Slough hay good. Upland hay not so good as previous year.
Cochrane Ranche Co.	5	26	4	176½	Oats, timothy, bromus, native grasses, vegetables	1	Bromus results satisfactory. Fifty two acres will be seeded down with bromus during the coming season.
Gunn, W. M.	9	2	5	35½	Wheat, oats, timothy, bromus	2	Too much rain to estimate the results from irrigation.
Moore, Wm.	10	25	3	10	Native grasses	3	Water supply in creek runs short too early in the season to make a success.
Riley, D. E.	18	29	4	....			No irrigation, owing to works being destroyed by floods. No results given.
McLaughlin, J. W.	19	29	4	90	Wheat, oats, native grasses, vegetables	1	Heavy floods destroyed a large portion of the crops, hence poor results.
Maunsell, J. W.	9	26 / 27	4	60	Oats	1	Exceptionally wet season interfered with irrigation. A few acres not irrigated only yielded one load to the acre.
Cook, H. F.	1	26	4	60½	Native grasses, vegetables	2	Exceptionally wet season rendered irrigation unnecessary.
Head, J. J.	2	21	4	33	Wheat, oats, timothy, vegetables	1	Exceptionally wet season rendered irrigation unnecessary. A few acres which were irrigated improved the crop. Consider fall irrigation good for all kinds of hay.
Indian Department (Blackfoot Reserve)			....	108½	Barley, oats, bromus, vegetables	1	Exceptionally wet season. Works partly destroyed by flood. Fall irrigation will be tried this season.
Nelson, John	8	1	5	60	Native grasses	2	Exceptionally wet season.
Wells, W. C.	26	6	5	....			Exceptionally wet season. No irrigation done.
Peterson, C. W.	23	1	5	160	Wheat, barley, oats, native grasses		Exceptionally wet season. Hay crop proved a failure owing to heavy irrigation being followed by copious rains.
Dowling, Annie	22	3	5	14	Barley, timothy		No details given.
Paterson, Robert	9	21	4	59	Timothy, native grasses	3	Unable to obtain water when most required for irrigation of crop.

Burn, H. St. G.	7	2	6	25	Oats, vegetables.	1	Heavy rains rendered irrigation of oats unnecessary. Garden was irrigated with good results.
Wallace, R. A.	19	28	4	22½	Oats, timothy, vegetables	1	All irrigable land was covered by flood during June. Ten tons of clear timothy was got from six acres of land.
Jones & Smart	19	15	3	210	Rye, native grasses	2	Most unfavourable season for six years. Every crop a comparative failure. Twelve acres of bromus look promising
Lyndon, C. A. & W. A.	12	29	4	1½	Vegetables	......	Irrigation not required owing to heavy rains. Garden gave first class results.
Banister, A. E.	22	28	4	50½	Native grasses, vegetables	1	Unable to cut hay owing to floods. Grass good quality. Vegetables best crop ever grown.
Elton, C. W. S.	8	1	5	32	Timothy, bromus, native grasses	2	Bromus made but a poor catch, although sown with a light crop of oats. Native rye grass yields well, but is not relished by stock. Irrigation not needed owing to heavy rains.
Brouard, S.	8	25	4	53½	Wheat, rye, native grasses	1	Good results. Am satisfied of the benefits to be derived from irrigation.
Wallace, A. T.	18	24	3	11	Oats, vegetables.	......	No details given.
Lachance, P.	8	25	4	67	Wheat, oats, timothy, native grasses	1	Part of timothy cut twice. Green oats also cut twice.
Glengarry Ranche Co.	12	29	4	135	Oats and rye mixed, timothy, vegetables	2	Heavy June rains destroyed part of oat crop. Timothy gave a splendid return. Excellent garden crop.
Elliott, W. B.	26	4	5	35	Wheat, oats, barley, rye, vegetables.	......	Ground well saturated from previous year and June rains rendered irrigation unnecessary. Crop a better average than either of previous two years.
Schmid, H.	18	4	5	100	Native grasses	1	Ditch not completed until middle of July and only one irrigation made.
Newson, A. C.	21	3	5	120	"	......	Land much too wet and cold. Crop about fifty tons less than off same land last year.
McCarthy, C.	10	23	3	5	Oats, vegetables.	1	No details given.
Jackson, F. A.	21	3	5	35	Native grasses	..	Dam destroyed by floods. Plenty of hay from other irrigated lands.
McHugh, T. P.	19	22	4	67	Barley, oats, vegetables	2	Ground well soaked the previous fall. Sufficient rains in June and July to render irrigation unnecessary. Straw off crop about 4½ feet long.
Canadian Land and Ranche Co.	12 13	28 19	3	930	Native grasses	....	Wet season and irrigation unnecessary.
Eckford, A. H.	18	29	4	67	Oats.	1	First time water used and found to be a complete success. On land that formerly grew nothing had a heavy crop as a result of irrigation.
Dixon Brothers	12	26	3	4	Vegetables	1	Hay made from corn grown on two acres of land. 25 acres sown to timothy, alfalfa and bromus, but not irrigated owing to ditch not being constructed to that point.
King, P. W.	23	1	5	60	Oats.	1	Shortly after seeding time the strong winds blew out the seed in considerable patches, otherwise I think the yield would have been considerably heavier. Wet and stormy weather in June and July rendered summer irrigation unnecessary.

BULLETIN No. 1.—Information from Irrigators, 1898.

Name.	Location of Lands. Tp.	Rge.	Mer.	Acreage under Crop.	Description of Crop.	Number of Irrigations.	General Remarks.
Peterson, C. W..	23	1	5	109	Wheat, barley, oats, timothy, native grasses, vegetables.	2	Water supply very erratic. Garden was properly irrigated and good results were most astonishing.
Canadian Land and Ranche Co.	12-13	22	3	510	Native grasses	1	No details given.
" "	13	19	3	319	" "	1	" "
Millar, M. T.	21	3	5	25	" "	2	Ditch damaged by floods, otherwise more land would have been irrigated.
Lane & Co., George	14	29-30	4	152	Timothy, native grasses, vegetables	1	Land irrigated previous fall. Irrigation proved a success with me. Don't think anyone can make a mistake if water properly used.
Banister, A. E.	22	28	4	31	Wheat, oats, vegetables	1	Results very satisfactory. Garden yielded best all round crop I ever grew.
George, F. W. B.	9	29	1	12	Wheat, oats, timothy, rye	1	Timothy a light crop, but was not irrigated early enough. Second crop from rye grasses, both good for hay and well worth cultivating, stock like these grasses well. Consider fall irrigation better for grain.
Ockley, J. W.	22	3	5	52	Rye, timothy, bromu , native grasses, vegetables.	2	Experimented with one acre of wheat and had good success. Oat yield magnificent, straw five feet long. Had excellent results from all lands irrigated. Find fall irrigation best.
Brown, M..	24	1	5	2	Garden and vegetables	2	Water only used on garden. Planted 270 trees and only lost two. Had several times tried to grow trees without irrigation, but failed.
Eckford, A. H.	18	29	4	32	Wheat, vegetables	2	Light soil and requires constant watering.
Patterson, J. D.	22	3	5	12½	Oats, barley, bromus, native grasses, vegetables	2	Potatoes were badly frozen. Consider it better to irrigate cultivated land in the fall.
Moseley, W. R..	22	3	5	20	Oats, timothy.	2	Oats badly frozen early in June.
Lloyd, A..	10	23	3	12	Oats	1	Fifteen loads of straw obtained.
Quail, W. H.	12	29	4	34	Oats, timothy, bromus, vegetables	2	About seventy five tons of oat straw obtained. Garden crop good.
Bann, H. St. G..	7	2	5	16½	Timothy, vegetables	3	Timothy not irrigated early enough. Potatoes gave a very large yield. Garden crop good.
Bolt, George	23	1	5	15	Oats		Oats cut green. Only about two thirds of crop irrigated.
Greeley, H. A.	10	26	3	14	Wheat, barley, oats, bromus, vegetables	2	Hot dry winds in June nearly ruined crop. Found that where water ran freely on prairie sod a good crop of blue joint grass sprung up. Shall pay some attention to this matter.
Hunter, Messrs..	22	3	5	84	Timothy, native grasse	2	All irrigated lands are black topped and heavy. Were well pleased with results and approve of irrigation.
Leeds & Elliott	12	28	4	41	Wheat, oats, timothy, vegetables	2	One irrigation made the previous fall.

Sharples, C.	12	28	4	60	Wheat, oats, timothy, native grasses, vegetables	8	Cut some very fine native grass raised entirely by irrigation; for years previously the land was bare of grass.
Indian Department, (Blackfoot Reserve)	...	...	..	76½	Oats, bromus, vegetables	2	Main canal only completed this year and unable to have a satisfactory test. Potatoes and garden stuff were used during the growing season.
New Oxley Ranche Company.	6	25	4	647	Oats, timothy, native grasses	1	Bromus was sown with the oats but made little showing during the year. Ditch broke during the spring and seventy seven acres of oats did not get enough water.
King, P. W.	23	1	5	80	Timothy.	2	First cutting after seeding, average length about thirty inches.
Card, C. O.	3	25	4	..	Garden stuff and vegetables.	1	Irrigated lands are in gardens in village of Cardston. All vegetables did well and were greatly aided by irrigation. Turnips and roots yielded from 200 to 500 bushels per acre, potatoes from 100 to 200 bushels to the acre.
Thibaudeau, J. B.	5	29	1	20	Oats, timothy.	1	Only necessary to irrigate once owing to wet season.
Braniff, D.	11	23	3	....	No details	2	Very heavy hay crop where freely irrigated. Wheat was destroyed by hail.
Furman, John	1	26	4	50½	Barley, oats, timothy, bromus, vegetables	...	Irrigated land is of five-fold value, safe with water, unsafe without. Oats weighed forty to forty three pounds per bushel.
Schmid, H.	18	4	5	100	Native grasses	2	No details given.
Turner, R.	21	3	5	60	" "	....	Ditch was destroyed and no details given.
Anderson, G., jr.	21	3	5	75	Oats, native grasses.	.	Dam destroyed by flood previous year and ditch filled up. Could not get water for irrigation when needed.
Anderson, G., sr.	21	3	5	15	Native grasses	..	" " " "
McCormick, James.	11	23	3	9½	Oats, vegetables.	3	Land was covered with water by overflowing of creek.
Hull Brothers & Co.	22	1	5	470	Barley, oats, timothy, bromus, native grasses, vegetables.	2	A great portion of timothy and bromus was sown five years ago, consequently results are not so satisfactory. Too much water is liable to kill bromus. Garden crop was exceptionally good.
McHugh, T. P.	19	23	1	150	Wheat, barley, oats, vegetables	1	Irrigating in the fall and again the following spring ensures a crop. Garden crop was the finest I have ever grown.
Dowling, Annie.	22	3	5	28	Barley, oats, timothy, vegetables.	1	Barley and oats cut green.
Moore, W.	10	25	3	50	Oats, native grasses	2	Oats irrigated once. Native grasses first watered in May and had two waterings afterwards.
Pollock, D. H.	7	21	3	62	Native grasses, vegetables.	2	Did not get very good returns, the grass thickened but did not grow to any length. Potatoes did well.
Lawson, H. C.	21	19	2	..	No details as to acreage. Native grasses.	...	Continuously irrigated a hay meadow of native grasses. Cut 375 tons of hay where previously only 175 tons have been cut. Ditch broke before I wanted to let water off, or would have cut more hay.
Austin, W. E.	20	1	5	10	Native grasses	10	No details given.
Wallace, A. T.	18	24	3	10	Wheat, barley, oats	2	Cut green for feed.
Dixon Brothers.	10	26	3	47	Oats, timothy and alfalfa mixed, bromus	3	Timothy and alfalfa was very thin and not worth cutting.
Cross, A. E.	16	1	5	4	Bromus, vegetables	3	Results very satisfactory.
Johnston, J. L.	21	22	4	55	Oats	...	Dam broke in spring and irrigation was impossible.
Lindquist, A. A.	1	26	4	30½	Timothy, vegetables.	.....	No details given.
Fisher, Joseph	21	23	5	200	Native grasses	3	Results very successful. Parts of the meadow were regularly irrigated at intervals, and the crop was the best return ever had since I began to irrigate.

BULLETIN No. 5. Information from Irrigators, 1900.

Name.	Location of Lands. Tp.	Rg.	Mer.	Acreage under Crop.	Description of Crop.	Number of Irrigations.	General Remarks.
Mosley, W. R.	22	3	5	. . .	. . . .	.	No details furnished. Rainfall sufficient without aid of irrigation.
Stewart, John	10	26	3	25	Barley, oats	1	All irrigation done prior to seeding, when land was soaked for about a week.
Hull Brothers & Co.	22	1	5	598½	Wheat, barley, oats, rye timothy, bromus, vegetables.	1	Fall irrigation. Oats and rye cut green.
Gardner M.	21	4	5	. .	. . .	. . .	No details furnished. Found irrigation unnecessary owing to wet season.
Fisher, Joseph	21	2-3	5	300	Native grasses	3	Cut nothing under irrigation except native hay; about 100 acres for feed for cattle in winter. Irrigation is a decided improvement on my land, even in the wettest of years.
Sheepy, Joseph.	22	1	5	. . .	. . . .	. . . .	Irrigation not necessary owing to plentiful rainfall. Find it very beneficial in dry seasons.
McLaughlin, J. W	19	29	4	153	Wheat, oats, vegetables.	2	Wheat cut green for hay.
Hammond, G. R	10	25	3	7	Wheat, oats	1	Sowed bromus with the oats and it came up good.
Woolt, J. W.	2	25	4	136	Timothy, bromus, native grasses	3	No details given.
Quail, W. H	12	29	4	30	Timothy, bromus.	1	" "
West, John N.	2	28	4	. . .	. . . .		No crop under irrigation this year.
Law, John	9	2	5	32	Oats, timothy, bromus	1	First year on ranche. Do not understand sufficient about irrigation to get best results.
Dudley, C. H	5	22	4	147	Wheat, oats	1	Only watered part of land cropped with oats, and on that piece got one third more yield than on balance of land cropped.
Rasmussen, R.	5	22	4	23	Wheat, oats, bromus, vegetables.		Had also three tons of fodder roots and one ton of garden truck. Used the three acres of bromus for pasture.
May, E. G.	24	2	5	. . . . . .	. . . .	. . .	On account of so much wet was unable to get hay off land.
Lachance, P	8	25	4	. . . . . .	. . . .	. .	No details furnished. Did not irrigate this year.
Lane, George.	14	29-30	4	152½	Oats, alfalfa, native grasses, vegetables	2	No information given as to yield of crop.
Vaughn, J. H	1	24	4	160	Native grasses	2	No details given.
Stewart, W. R	11	29	4	187½	Wheat, oats, timothy, vegetables		Seven acres of pease were hailed out and cut for hay.
Burn, H. St. G.	7	2	5	40	Oats, timothy, vegetables.	1	Timothy had been in too long; it grew thick in bottom but not to any length. Oats did not require water owing to heavy rainfall.
Pollock, D. H	7	21	3	78½	Oats, native grasses, vegetables	2	Oat crop not threshed; had about three tons of straw for feed. Garden truck did well. If weather is warm and dry do not think hay land can have too much water, providing water is not too cold. Have known meadows to be ruined by cold spring water.

Pearce, William	24	1	5	....		...	Irrigation not required owing to wet season. A little irrigation was done on garden, with good results. Have slight experience with fall and spring irrigation. Late fall irrigation gave excellent results; it left the soil in splendid condition for beneficial action of the frost during winter, the ground being ploughed and thrown up loose, so that the seed bed the following spring was in best possible condition. I tried spring irrigation once, immediately after the grain was sown, and it was too dry to start the grain to sprout. The results were all right on my side, but on soils containing a large amount of clay, there would be the possible danger of "baking."
Salt, R. S. & E.	1	26	4	20	Native grasses	....	No particulars given as to yield. This is our first year for irrigation, we cut about four times as much hay on land irrigated as we did on same land without irrigating in previous years. Water on native grass continuously from April to July.
Cyr, Dolphis	6	29	4	100	Timothy, native grasses	...	On native grass land needs used water continuously from April to July.
Carter, D.	22	2	5	60	Timothy	1	No details given.
Harker, E.	3	25	4	20	Native grasses	1	Land was used for pasture, but there was a good yield. Little irrigation required owing to frequent rains.
Sex Smith, J. L.	18	28	4	....		...	No details furnished. Owing to wet season no irrigation was necessary.
Banister, A. E.	22	28	4	35	Oats	...	Had about 20 tons of straw. Owing to wet season no irrigation was necessary.
Wallace, R. A.	19	28	4	505	Oats, timothy, native grasses, vegetables	1	Season too cold for good results.
Stuart, W. D.	24	4	5	49	Wheat, oats, rye, vegetables	..	Grain and rye crops cut green for hay.
Evans, James	5	21	4	21	Wheat, oats, vegetables	.	These crops were all on new ploughed sod.
Glengarry Ranch Co.	12	29	4	161	Oats, timothy, vegetables	1	About 20 acres of oats were sown on sod ploughing (old meadows broken up in spring); rather light crop. Had a fine crop of timothy, a volunteer crop from the sod ploughed under in the spring. Season wet, and only one application of water.
Elton, C. W. S.	8	1	5	36	Timothy, bromus, native grasses	2	I believe late fall irrigation is conducive to early growth in spring. Owing to wet weather during haying time some of the brome and native (rye) grass was badly beaten flat, largely due to heavy crop and extra rank growth. Part of the timothy was irrigated slightly in the fall, after the crop had been taken off.
New Oxley Ranch Co.	6	25	4	582	Oats, timothy, bromus, native grasses, vegetables	3	No details as to yield of hay and vegetables. Had about 2 tons per acre of oat straw. Think early irrigation is best. Some fine timothy and bromus has been raised by irrigation, where without irrigation it would have been very little use. No fall irrigation has been done in this section.
Anticknap, H.	18	18	2	..		..	No results owing to destruction of dam.
Brown, O. E.	24	1	5	....		.	No irrigation was done owing to very wet season.
McHugh, T. P.	19	22	4	89	Oats, vegetables	2	No details *re* yield of vegetables. Find that spring and fall irrigation suits my land best, as it is clay bottom and holds the moisture. We had sufficient rains through the summer to keep the growth up.
Robertson, T. W.	19	28	4	500	Native grasses	1	No details given.
Norrish, J. D.	15	29	4	55	Timothy, native grasses	1	" "
Lindner, John	6	29	3	5¾	Oats, vegetables	3	Oats cut green. Garden truck did very well.

BULLETIN No. 5.—Information from Irrigators, 1900.

Name.	Location. Tp.	Rg.	Mer	Acreage under Crop.	Description of Crop.	Number of Irrigations.	General remark
Lyndon, C. A. & W. A.	12	29	4	51½	Wheat, oats, timothy, bromus, vegetables	3	Half the oat crop cut green for hay. Poor yield of potatoes; used too much water. Good yield of garden truck.
Thibaudeau, J. B.	5	29	4	53½	Wheat, oats, timothy, bromus, native grasses, vegetables.	2	Had 25 tons of oat straw. No results given as to vegetable crop
Jones & Smart	19	15	3	35½	Timothy, bromus, native grasses, vegetables	3	No details given.
McKinnon, John.	21	2	5	390	Wheat, native grasses	2	Wheat (mixed) cut green for hay.
Marshall, H	5	29	3	104½	Barley, oats, native grasses, vegetables	2	Barley and oats cut green, but yield not given. Had to keep water on the native grasses continuously on account of the quality of the soil; it hardens when it is dry and stops the growth of grass.
Godsal, F. W.	7	1	5	....	....	....	No irrigation required owing to sufficient rainfall. Fall irrigation would do no good as the soil does not hold the water, gravel being immediately underneath.
Lee, W. R.	6	1	5	....	....	....	No irrigating done this season, as the rainfall was too copious during the growing season.
Indian Dept. (Blackfoot Reserve).				162½	Oats, vegetables.	..	No irrigating done this season, owing to sufficient rains. Had about 400 tons of oat straw.
Braniff, D	11	23	3	192	Wheat, barley, oats, bromus, native grasses, vegetables.	2	No details given.
Greeley, H. A	10	26	3	53½	Wheat, barley, oats, bromus, native grasses, vegetables.	1	No record kept of results.
Peterson, C. W	23	1	5	....	....	..	No irrigating done owing to wet season.

BULLETIN No. 6. Information from Irrigators, 1901.

Name.	Location of Lands. Tp.	Rg.	Mer.	Acreage under Crop.	Description of Crop.	Number of Irrigations.	General Remarks.
Moseley, W. R	22	3	5				No particulars furnished. Irrigation not required owing to sufficient rainfall.
Stewart, John	10	26	3	53	Wheat, barley, oats, speltz	1	Had 83 tons of straw after threshing. Barley was badly damaged by hail. All irrigation was done prior to seeding when land was soaked for a week.
Hull Brothers & Co.	22	1	5	283½	Wheat, barley, oats, speltz, timothy, bromus, vegetables.	1	Land was irrigated during the previous fall. Also cut 300 acres of oats green and had 1,200 loads. All kinds of vegetables and hay were good crops.
Gardner, M.	21	1	5			...	No details supplied. Irrigation was not required.
Fisher, Joseph	20-21	2 3	5	300	Native grasses	3	" " Part of the hay was left for winter feed for cattle.
Sheepy, Joseph..	22	1	5			...	No details supplied. Irrigation was not required. Irrigation is a great help in dry seasons, especially for killing out 'foxtail'.
Johnson, E.	22	3	5	39	Barley, oats, timothy.	2	Oats cut green. Had about 9 tons of barley straw after threshing. I believe in irrigation.
McLaughlin, J. W	19	29	1	151½	Timothy bromus, vegetables	2	First crop of timothy and bromus.
Hammond, G. R	10	25	3	7	Bromus, vegetables.	1	Of the vegetable crop about 10 tons were turnips. About July 1 all crop was destroyed by hail, and only a poor crop came up afterwards.
Woolf, J. W	2	25	4	136	Timothy, bromus, native grasses	3	No details given.
Quail, W. H	12	29	1				Irrigation not necessary owing to bountiful rains. No particulars supplied.
West, J. N. ..	2	28	4			..	Irrigation not necessary owing to bountiful rains. No particulars supplied.
Law, John..	9	2	5	19	Oats, timothy, native grasses	...	Oats cut green. Too much rain to say what effect irrigation had.
Rasmussen, R ...	5	22	4	84½	Wheat, oats, bromus, vegetables.	.	Had 30 acres of fall wheat sown in September and November of previous year. 20 acres of oats were on breaking. No irrigation necessary.
New Oxley Ranche Co., Secs. 21 & 27.	6	25	4	335	Oats, timothy, bromus...	..	Oats cut green. Season wet and not much irrigation necessary. Land kept constantly moist. It is hard to give timothy too much water.
Sharples, C......	12	28	4	72	Oats.	1	I had water on before breaking and thoroughly soaked the land. The green feed grown on this land was very heavy and grew fast. Some 10 acres broken and sowed without irrigation did not yield nearly so well, although sown earlier.
May, E. G.	24	2	5				Unable to get on land on account of so much wet.
Lachance, P....	8	25	4			....	No details supplied. Irrigation not required owing to so much rain.

BULLETIN No. 6.—Information from Irrigators, 1901—*Continued.*

Name.	Location of Lands. Tp.	Rg.	Mer.	Acreage under Crop.	Description of Crop.	Number of Irrigations.	General Remarks.
Nelson, John	8	1	5	79½	Oats, native grasses, vegetables. . .	. . . .	I first irrigated on May 1 and kept changing the water on it till July 15. Oats should not be irrigated until stooling is complete, otherwise the stooling is stopped. Oats irrigated before stooling is completed will ripen from 10 to 15 days earlier than if irrigated later. Barley will not stand irrigation, it turns to smut. Onion seed sown April 1, and watered immediately and kept irrigated until they are the size of a five cent piece, if too much water used it keeps them growing and keeps the heart soft. I raised 6,000 lbs. on ¼ of an acre. Cabbage will take all the water that can be given them. I got 12,000 lbs. from ¼ of an acre. Cauliflower require to grow in water from the time they commence heading until they finish growing. Had 2,300 lbs. from ¼ of an acre. Carrots will stand lots of water, I got 6,000 lbs. from ¼ of an acre. Parsnips, turnips and swedes require very little water. I over irrigated them which made light yield and poor quality. From ¼ of an acre I had 2,400 lbs. of parsnips, and 2,800 lbs. swedes from ¼ of an acre. An irrigator must use his own judgment, and consider the nature of the land he is working on, whether clay or gravel subsoil. My experience is that with a gravel bottom too much water cannot be put on, but on clay subsoil it takes a practical man to handle the water, if too much water is used it will settle to the lowest places in the field and drown out that spot, no matter how large or small it may be. My experience with timothy is, the sooner water is put on in the spring and the more water used, the more hay will be got.
Lane, George	11	29-30	4	202½	Oats, alfalfa, native grasses.	2	No details given.
Fauquier, H. H. . .	10	25	3	24	Wheat, barley, oats, bromus, vegetables. . .	2	Had 2000 head of cabbage. Had 18 loads of straw after threshing grain. All crops badly spoiled by hail.
Vaughn, J. H	1	24	4	163	Timothy, native grasses.	2	No details given.
Stewart, W. R. . . .	11	29	4	247½	Wheat, oats, timothy, bromus, native grasses, vegetables.	. . . . .	Oats cut green. Had eighty tons of straw after threshing. Vegetables include 300 bushels of pease from ten acres, sown to that crop. On account of wet season did not irrigate any land.
Burn, H. St. G	7	2	5	11	Barley, oats timothy, alfalfa, vegetables. .	. . .	Timothy was too thick in some places and will have to be well disced or ploughed up. Alfalfa was only sown last spring (with oats) had a good growth about a foot high. If it stands the winter, will irrigate next spring.

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Pollock, D. H.	7	21	3	84½	Oats, native grasses, vegetables	2	I had good success with all kinds of garden truck, with the exception of tomatoes which do not ripen. Have raised nearly every kind of vegetable this season and had them good. It is impossible to raise a garden in this part of the Territories without irrigation. I had a splendid crop of blue joint hay this year. I let the water on hay land as soon as I consider the ground is warm enough. June, this year, was cold, and I did not have water on once during that month. Had it on in May but only for a short time.
Pearce, William	24	1	5	....		.	No details given. Irrigation not required owing to wet season.
Salt, R. S. & E.	1	26	1	20	Native grasses	.	No details given. We had a much heavier crop of hay where irrigated.
Burke, A. E.	12	30	1	61	Oats, vegetables	...	Oats cut green. Irrigation not required owing to wet season.
Cyr, Dolphis	6	29	1	95	Timothy, native grasses	....	Land was irrigated continuously from April to July. No details given.
Blumel, F.	5	22	1	1	Wheat	1	No details given.
Carter, D.	22	2	5	60	Timothy	1	No details given.
Sex Smith, J. L.	18	28	1	...		.	Irrigation not required. Growth was good; owing to wet season.
Banister, A. E.	22	28	1	33	Oats	.	Irrigation not required. Land sufficiently moist by rains. Had sixteen tons of straw after threshing.
Wallace, R. A.	19	28	1	535½	Wheat, oats, timothy, native grasses, vegetables	1	No record kept of yield of wheat and vegetables. I irrigated only a small portion of timothy, when rains coming on, we stopped, but wherever water was used the hay was much better.
Stuart, W. W.	24	4	5	13½	Wheat, barley, oats, rye vegetables	.	Wheat, oats and rye cut green. Irrigation not necessary owing to so much rain during the season.
Evans, James	5	21	1	41½	Wheat, oats, vegetables		No irrigation necessary. Had ten acres of fall wheat, sown on Oct. 25, 1900, harvested on Sept. 10, 1901, yielded 30 bushels per acre. Also sowed one-tenth of an acre with Persian wheat on May 10, harvested on Sept. 28, yielded 7½ bushels.
Glengarry Ranche Co.	12	29	1	252	Oats, timothy, bromus	..	Wet season and irrigation not required. Early part of season was cold and backward. Timothy was rather short. Bromus first crop, only about half the field went to seed, season too cold. Our ground is heavy clay loam and wants warm weather to give good results.
Elton, C. W. S.	8	1	5	40	Timothy, bromus, oats		Twelve acres of unirrigated timothy yielded fifteen tons, and seven acres of unirrigated bromus yielded eight tons, while unirrigated native grass gave but two thirds of a ton per acre. Irrigation helped the hay crop over in hot dry weather in June and July. Timothy was slightly irrigated in the previous fall.
New Oxley Ranche Co. Secs. 18 and 19	6	25	1	672	Oats, timothy, bromus, native grasses, vegetables	5	No record of yield of hay. Think early irrigation is best. Some splendid bromus and timothy has been raised. As a rule four or five irrigations are sufficient. No fall irrigation has been practised.
Anticknap, H.	18	18	2	11	Garden stuff	2	No details furnished. Spring was dry, but summer was very wet. All kinds of garden stuff received benefit from irrigation.
Brown, O. E.	24	1	5	...		.	No detailed information supplied. Irrigation not required owing to wet season.
McHugh, T. P.	19	22	1	89	Wheat, vegetables	2	No information given as to yield of vegetables. Wheat cut green.
Robertson, T. W.	19	28	1	890	Timothy, native grasses	1	Good results. Timothy was disced in on the sod.

BULLETIN No. 6. Information from Irrigators, 1901.—*Concluded.*

Name.	Location of Lands. Tp.	Rg.	Mer.	Acreage Under Crop.	Description of Crop.	Number of Irrigation.	General Remarks.
Norrish, J. D.	15	28 & 29	4	71	Oats, timothy, native grasses	2	Had 12 tons oat straw after threshing.
Lindner, John	6	29	3	32	Wheat, oats, native grasses, vegetables	1	Wheat not threshed, but a good crop. Had 8 tons of oat straw after threshing. Garden truck was a good yield.
Lyndon, C. A. & W. A.	12	29	4	81¼	Wheat, oats, timothy, bromus, vegetables	1	Wheat and oats cut green. Spring and early summer were wet and no irrigation was necessary. Everything in garden grew well and ripened in time. Water put on the land in the previous fall.
Thibaudeau, J. B.	5	29	4	84½	Wheat, oats, timothy, bromus, native grasses, vegetables.	4	Had 34 tons of wheat and oat straw after threshing. Also had 4 tons of oats cut green.
Jones & Smart	19	15	3	31½	Bromus, native grasses, vegetables	3	Had 25 tons of hay and 100 bushels of potatoes.
Miller, M. T.	21	3	5	18¼	Oats, rye, timothy, alfalfa, bromus, vegetables	....	No irrigation required on account of heavy rainfall. Oat and rye cut green for hay.
Marshall, H.	5	29	3	104½	Oats, native grasses, vegetables	....	My hay meadow has been irrigated four seasons, but did not yield any crop until 1900, as I did not keep it wet enough. For the past two seasons have kept water on continuously and have had good crops.
Patterson, Robert	8	24	4	20	Native grasses	1	Owing to repairs to ditch was unable to irrigate grain, &c.
Godsal, F. W.	7	1	5	....	....	....	No details furnished. Irrigation not necessary as the rainfall was sufficient and came when needed. Green feed was caught by snow before ready to cut, and badly beaten down.
Lees, W. R.	6	1	5	....	....	....	No details furnished. Irrigation not required owing to plentiful rainfall.
Indian Dept. (Blackfoot Reserve.)	...	..		162¼	Oats, vegetables	....	Had 400 tons of oat straw after threshing. Irrigation not required owing to wet season.
Dixon Brothers	10	26	3	69	Oats, alfalfa, bromus, native grasses, vegetables.	3	The past season was a favourable one. Land well cultivated would produce good crops this year without irrigation.
Braniff, D.	11	23	3	229¼	Wheat, barley, oats, pease, bromus, native grasses, vegetables.	3	We got completely hailed out twice this season, first storm on July 2, mowed the crops close to the ground. Grain crops were the best I ever saw in any country, previous to the storm. The second storm on August 5 destroyed the second crop of grain and a good deal of tine hay. Those were the first hailstorms I have seen in the country.
Greeley, H. A.	10	26	3	53½	Wheat, barley, oats, bromus, native grasses, vegetables.	1	Cut 12 acres of barley green. No record kept of hay crop. The ground for grain and roots was well saturated before sowing. No irrigation after crops were up. Heavy hailstorm on July 1 injured all crops, particularly barley, which had nearly all heads cut off.

Quorn Ranche Trustees.	20	2	5	....	... .	....	Owing to wet season irrigation was not necessary. Unable to furnish required statistics.
Peterson, C. W.....	23	1	5	....	....	.	Owing to wet season irrigation was not necessary. No information furnished.

The consensus of opinion as to results from irrigation as scheduled above indicates that during dry seasons most satisfactory results have been obtained. The crops raised have included all the coarse grains and fodder crops, together with vegetables, and particular attention is directed to the statements made by several irrigators that good crops of grain, hay and vegetables have been obtained by irrigation from land which previously produced nothing but a sparse crop of native grass, the experience so far obtained, and as is indicated above, shows that but poor results are obtained from the irrigation of native wild grasses. In many cases one or two applications of water have improved the growth of these grasses, but ultimately it is found that a new grass comes up in these irrigated meadows, and that the old grass is more or less killed out. This is easily understood when it is remembered that the native grass in the semi-arid region is the product of more or less arid conditions, and that the supplying of extra moisture through irrigation will necessarily change the character of the native grass. Realizing these facts, many irrigators have broken up large areas of meadow land under their ditches, and have gone in for timothy, bromus, rye and other fodder crops, with most gratifying results.

METHODS OF IRRIGATING.

So far the methods followed by irrigators in the semi-arid district in supplying water to their crops have been simple, and it is found in many cases that the best judgment has not been used. In irrigating hay meadows a simple process of flooding is followed, while for grain or vegetable crops the water is conducted through the crops in small furrows. Both systems are dependent upon getting the distributing ditches, which take the water from the main ditch or canal, located along the highest land in the field to be irrigated, so that the water will flow easily and quickly over the lower portion of the field. The laying out of these main laterals or distributing ditches is a matter requiring intelligent care and judgment, and is not given sufficient attention by many of our irrigators. As a consequence the water is not evenly distributed or readily controlled, and the result is noted in the uneven character of the crop and in the creation of swamps in low lying spots.

Irrigation, to produce the best results, should be accompanied with sufficient drainage, and should carefully avoid the use of too much water. Unfortunately, this matter is one requiring considerable education and experience, and it will take time to give our irrigators a due appreciation of the disastrous results which follow from overloading or waterlogging the soil with an excessive quantity of moisture.

It is erroneous to suppose that irrigation farming can only be successfully undertaken by those having special knowledge and means. The irrigation development of western America has been accomplished by immigrants who had no previous knowledge of the growth of crops by the artificial application of water, and although experience in this, like all other kinds of farming, is valuable, some of the most successful results in our semi-arid districts have been obtained by settlers who had practically no guide but their own common sense in irrigating their crops. The tendency to use too much water is common with all irrigators, but intelligent observation of his crop's growth should soon teach the irrigation farmer that harm instead of benefit is sure to result from wasteful and careless methods in applying water.

Irrigation is practically an insurance on the production of crops, and there is no doubt that the small farm well irrigated, is a much more certain source of livelihood and of possible surplus earnings, than the large farm situated in a sub-humid region and subject to sporadic droughts.

The results from irrigation are largely dependent upon the intelligence and energy brought to bear in constructing the systems for the distribution of the water, and in producing crops by the application of this water to the land; successful agriculture or horticulture by the method of irrigation is as much dependent upon energy and hard

work as is success in any other branch of industry. The irrigator, however, knows that his hard work will bring a sure return, and he, therefore, has an inducement to energy and thrift which is not experienced by the farmer who is dependent upon varying conditions of rainfall to supply the moisture needed by his growing crop, and is never sure of his harvest until the crop is cut.

Irrigation is not the panacea for all ills which some claim and expect from it, but that it will render a large portion of the arid region now useless and unproductive capable of supporting a dense and prosperous population is beyond argument.

EFFECT OF IRRIGATION ON SUMMER FROSTS.

The question of the effect which irrigation will have in increasing or decreasing the summer frosts which occur in certain portions of the arid region is one of deep interest to the residents of these districts.

At first glance it would seem that the wetting of any considerable areas of land would have the effect of cooling the atmosphere and increasing the probability of frost, for it is within the experience of many that low, wet or swampy lands are very much more subject to frost than the high and dry bench lands. However, the data obtainable regarding the experience of certain of the states and territories in the United States upon this subject leaves no room for doubt that the application of water through irrigation has quite a contrary effect to that mentioned, and that the recurrence of summer frost has been diminished thereby.

It is not proposed here to go into a discussion of the probable reasons for this phenomenon, such discussion being deferred until data founded upon the experience of our arid region, and corroborative of that mentioned, can be quoted, and the matter fully and intelligently dealt with. It will probably be sufficient at this time to state the fact that in certain of the irrigation areas in the central and northern irrigation states much disappointment and loss were experienced in the early days of irrigation owing to summer frosts, and that in these same districts the recurrence of frosts is becoming much more rare, and crops are now successfully raised, which, owing to their susceptibility to frost, would not have been attempted by the most sanguine many years ago. It will also be of interest to note that in Southern Alberta during the past year the writer observed irrigated crops which were untouched by frost while adjoining unirrigated portions were destroyed, these remarks being equally applicable to vegetables and grain.

From a careful consideration of the facts obtainable upon this subject it may safely be assumed that among the beneficial results which will accrue to our arid areas from irrigation, not least important will be the favourable influence which it will have in diminishing summer frosts.

IRRIGATION SURVEYS

IRRIGATION SURVEYS.

When the movement towards the introduction of irrigation works in the semi-arid region became pronounced, it was at once realized that it developed upon the government to undertake the general irrigation surveys in the region necessary to provide such information regarding the general contour of the country, the source and quantity of the water supply, and the possible and proper distribution of the same, as would be required to enable the government to properly administer the law relating to the use of water for irrigation which was passed about that time, and secondarily as a foundation for the subsequent detailed surveys which might be undertaken by companies or individuals preliminary to the construction of irrigation works.

The surveys which after careful consideration of the work of a like character which was being done in other countries, it was finally decided to undertake, consisted of two distinct classes of work, viz.:—Topographical surveys, to determine the general contour and elevations in the semi-arid region, and hydrographic surveys, to determine the location and volume of the water supply. To these was subsequently added, as is explained more fully further on, the preliminary location of certain main irrigation canals, which are intended to reclaim large areas by diversion of water from some of the larger streams.

The surveys of the classes referred to have been carried on largely as independent operations, and about in the order mentioned; they are, therefore, dealt with under separate headings for convenience of reference.

TOPOGRAPHICAL SURVEYS.

The area embraced within the tract which will ultimately be covered by the topographical surveys contains a wide range of different classes of country. In the eastern and middle sections we have open plains comparatively flat, and unbroken in contour, while in the west the high, rolling foothill country is met, and finally on the western boundary of the tract the steep slopes and broken contour of the eastern face of the Rocky Mountains are encountered.

These areas being so widely different in character naturally require different treatment in carrying on topographical surveys, and in fact two systems showing wide differences both in foundation and details have been followed.

Prior to the inception of the irrigation surveys the greater part of the open or plains region, and a portion of the foothills district, had been covered by the surveys performed under the land survey system, and these surveys, therefore, provided the skeleton outline of distance and direction required as the foundation for further topographical investigations. These land surveys have been clearly defined upon the ground with more or less permanent marks at all township and section corners, and the use of these marks did away with the necessity of adopting any system of triangulation or geodetic surveying to locate topographical features or establish points of departure. Our topographical surveys were, therefore, designed to build up on the skeleton outline provided by the land surveys the necessary additional information to permit contour maps of the country to be issued as a basis for all future detailed surveys for irrigation undertakings. Several different systems of obtaining the necessary topographical data upon which to base these maps presented themselves, but the scheme of work as finally adopted was as follows, dealing first with the work in the open or plains region.

The country has been divided into blocks by following the township outlines, these blocks varying in size from four townships, or 144 square miles in the broken or foot-

hills region, to sixteen townships, or 576 square miles in the more open and gently rolling portions.

Along the lines bounding the blocks careful levels are run which are all referred to the common datum of sea level, the elevations being determined at sufficiently frequent intervals to enable contours to be located, and the general topography along these lines is noted from careful chainage, using steel band chains.

At points where streams or other permanent features are intersected, and in all cities, towns or villages intersected by or adjacent to the lines being run, permanent bench marks are established and properly numbered and marked for future reference.

The skeleton outline provided by above operations is then used as a basis for the completion of the detailed surveys of the topography within the blocks. Originally the scheme followed in completing this contour survey was to trace the main contours by rapid traverse surveys from one boundary of the block to the next, determining the elevations by use of aneroid barometers, and filling in details by rapid sketches. This system, however, did not produce satisfactory results, and was soon abandoned for a system based upon the use of Short's telemeter level, which it may be of interest to explain somewhat in detail, as it has produced very satisfactory results, and has been used for the first time in Canada on this work.

The main features are: the measurement of distances without the use of a chain; the computation of elevation by means of vertical angles, and the automatic method of obtaining gradients on slopes.

Distance is obtained by taking two readings at different vertical angles on the rod, which is an ordinary engineer's levelling rod divided to hundredths of a foot.

The horizontal circle of the telemeter is graduated from 10½ up to 1,200. Certain stated numbers on the circle are designated as pairs, and must always be used in conjunction with one another for the double readings necessary in this work. The entire upper surface of the horizontal circle is shaped to form a curve, so that when the telescope is revolved it is mechanically tilted either up or down as desired. If the telescope tilts upwards when revolved, the leveller need only reverse it end for end in the Y's to obtain the opposite result, viz.: a downward tilt; in fact, one end of the lower bar bears the word 'Rise' and the opposite end 'Fall,' so that the leveller merely has to keep the telescope eyepiece over the word applicable to his sights.

For example: Suppose that a steep rising bank has to be levelled up, the leveller places the eyepiece end of his telescope over the word 'rise,' he then clamps the index at zero on the horizontal circle and levels the instrument as if it were an ordinary Y level. After this he revolves the telescope until the cross hair intersects the rod near either extremity. The position of the index on the vernier is then noted, and the most adjacent pair selected. Suppose this pair to be 12½ and 16⅔, the reading at 12½ is 12 feet, and at 16⅔, 4 feet, which gives a distance of 800 feet from instrument to rod, because the difference between the two readings of any pair is the horizontal distance in feet, counting each hundredth of a vertical foot on the rod as one foot horizontal. Thus distance is obtained by the simple method of subtracting the less from the greater reading.

The ground elevation of the rod above the ground elevation of the instrument is computed for a 'fall' reading by dividing either one of the pair numbers into the horizontal distance, then adding the rod reading of the pair number used to the dividend and subtracting the height of the instrument from the result. For a 'rise' reading the height of instrument is added and the rod reading subtracted, just reversing the 'fall' computation.

The gradient of the ground surface between instrument and rod is obtained by revolving the telescope on the horizontal circle until the reading on the rod corresponds with the height of instrument; then the number to which the index points on the horizontal circle represents the distance in which a rise or fall of one foot occurs. For example: The height of instrument is 5·0 feet, by revolving the telescope the cross hair is brought to intersection with this number on the rod; the index now rests at 75·7=

gradient, 1 foot in 75·7 feet. The taking of gradients in this manner forms a valuable check on the levels.

The telemeter can be used as an ordinary Y level by reading the rod with the index clamped at zero, then revolving from zero to 100 (to obtain distance) 0 and 100 being a pair. To work the telemeter level to its best advantage a long base is necessary, that is to say, the longer the horizontal base is the greater the vertical angle will be. My greatest vertical distance taken at one reading was 138 feet, and the base (or distance from instrument to rod) was 1,415 feet. The rod used being a 16-foot one, limited my length of base to 1,600 feet theoretically, but practically to between 1,500 and 1,600 feet.

The results of our topographical surveys as finally issued for public information will be readily noted for the accompanying maps.

In completing the topographical surveys to date, 1,475 miles of levels have been run along the outlines of blocks, and some 1,956 miles of levels have been run with the telemeter level in determining contour intervals.

The area so far covered by the detailed topographical surveys comprises 2,256 square miles, and the average cost of the work amounts to the very low figure of $2.59 per square mile.

The permanent bench marks which have been established in connection with topographical surveys so far completed are scheduled below for convenience of reference by those who may find it necessary to refer to such marks in connection with surveys they may have in hand for irrigation ditches or canals.

SCHEDULE of Bench Marks established since June, 1894.

No.	Location.	Sec.	Tp.	Rge.	M.	Elevation.	Remarks.
1	On N.W. cor. Calgary post office	15	24	1	5	3401·00	2nd course.
2	On S.E. cor. Calgary court house	16	24	1	5	3406·00	5th "
3a	On Waterworks chimney	16	24	1	5	..	Effaced by action of weather.
3	At N.E. corner	36	24	2	5	3607·60	On I.P.
4	On Nose Hill 2 chs. N. of a point 20 chs. E. of N.W. corner	31	24	1	5	3841·40	On sandstone outcrop.
5	125 ft. S. of Elbow river 52 17 chs. S. of N.E. cor	25	23	2	5	3490·02	On I.P.
6	10 chs. W. of N.E. cor	34	24	2	5	3468·40	"
7	35 chs. S. of N.E. cor. (13 ft. E. of Fish creek)	1	23	2	5	3488·15	"
8	At N.E. cor. of	36	24	3	5	3784·15	"
9	26 ft. S. of Pine creek 25 chs. S. of N.E. cor	1	22	2	5	3538·45	"
10	At N.E. cor. of	36	21	4	5	8959·89	"
11	5 ft. N. of centre of Md. at N.E. cor. of	36	20	2	5	3799·71	"
12	35 27 chs. W. of N.E. cor	31	24	4	5	3962·50	"
13	40 ft. S. of Sheep river 49 chs. S. of N.E. cor	25	20	2	5	3609·80	"
14	1 ch. N.W. of ¼ E. of	13	24	4	5	3873·40	" destroyed by new bridge construction.
15	30 ft. N. of High river 33′ W. of E. Bdy, sec. 1 & 55 chs. S. of N.E. cor.	1	18	2	5	3694·61	On sandstone slab 6 ft. x 2 ft. x 1·5 ft.
16	At N.E. corner	36	22	4	5	4514·60	On I. P.
17	50 ft. N. of S. branch, Highwood river 10 E. of point 47 05 chs. S. of N.E. corner	36	17	2	5	3732·73	On sandstone slab 3 ft. long x 10 in. thick.
18	11 70 chs. S. of Fish creek at N.E. cor	24	22	4	5	3965·25	On I.P.
19	75 ft. W. of S. fork Highwood river 20 chs. W. of N.E. cor	33	16	2	5	3974·60	" approximate elevation only.
20	At N.E. corner	1	22	3	5	3890·60	"
	"	36	16	3	5	4545·20	" (not marked).
21	"	36	16	2	5	4403·52	"
22	"	2	21	3	5	3817·10	"
23	74 ft. W. of Mosquito creek 11 98 chs. W. of N.E. cor	35	16	29	4	3352·60	"
24	Intersection of W. limit, C. & E. right of way, with N. Bdy. S. 35, 16 65 chs. W. of N.E. cor.	35	20	1	5	3473·50	"
25	50 ft. W. of C. & E. Ry 3 81 chs. E. of N.E. cor	31	16	28	4	3342·20	"
26	10 chs. E. of N.E. corner	31	20	28	4	3213·70	"
27	105 ft. N. of Mosquito creek 10 5 chs. S. of N.E. cor	12	16	28	4	3277·02	"
28	At N.E. corner	36	20	28	4	3540·75	"
29	50 ft. W. of C. & E. Ry. 1 46 chs. N. of N.E. cor	25	15	28	4	3344·63	"
30	At N.E. corner	36	19	29	4	3398·65	"
31	50 ft. W. of Litttle Bow river 20 chs. W. of N.E. cor	31	16	24	4	3174·08	"
32	On S.E. cor. stone, 5th course, E. wall of High River Trading Co	6	19	28	4	3371·25	On H. R. T. Coys. store, High river, 5th course.
33	At N E. corner of	36	16	26	4	3315·10	On I.P.
34	At S.E. corner of	1	19	28	4	3267·85	"
35	89 ft. N. of Little Bow river 5 chs. S. of N.E. cor	12	15	26	4	3079·60	"
36	At N E. cor	36	21	28	4	3304·40	"
37	"	36	12	26	4	3196·80	"

38	1·53 chs. S. of C.P.Ry. 16·60 chs. S. of N.E. cor	13	23	28	4	3330·10	"
39	At N.E. cor. of	12	9	26	4	3060·18	"
40	"	36	24	28	4	3277·70	"
41	"	36	5	26	4	3338·41	"
42	"	36	23	26	4	3213·65	"
43	"	36	4	27	4	3495·66	"
44	2 ft. N. of S.E. cor. C.P.Ry. station grounds, Shephard, E. Bdy.	13	23	29	4	3338·50	On I. P.
	At intersection of E. Bdy., R. 26, with S. Bdy. of Blood Reserve, N.E. cor.	12	3	26	4	3876·50	" Marking S. Bdy. of Blood Indian Res.
45	At S.E. cor	1	3	28	4	4138·11	"
46	At N.E. cor	36	24	29	4	3512·45	"
47	At S.E. cor.	1	3	29	4	4352·76	"
48	At N.E. cor.	34	24	1	5	3405·40	" Removed by settlers.
49	Opposite J. Nelson's house, 25 chs. S. of N.E. cor.	36	2	26	4	3793·12	"
50	At N.E. cor	36	26	2	5	3871·20	"
51	120 ft. N. of St. Mary river, at S.E. cor	6	1	25	4	4136·54	"
52	0·92 chs. W. of C. & E. Ry.; 56·75 chs. E. of N.E. cor.	34	28	1	5	3562·60	"
53	On International Bdy., 8·10 chs. W. of Milk river; 35 chs. E. of S.E. cor.	4	1	23	4	4131·33	"
54	At N.E. cor	36	28	28	4	3166·00	"
55	On International Bdy., at S.E. cor.	1	1	23	4	4595·10	"
56	45 ft. N.W. of a point 5 chs. E. of N.E. cor	33	28	28	4	3137·05	On sandstone ledge.
57	At N.E. cor	36	4	23	4	3407·80	On I. P.
58	"	36	28	2	5	3744·60	"
59	"	34	4	24	4	3600·00	"
60	20 ft. E. of Beaver dam creek, 20 ft. S. of point, 6 chs. W. of N.E. cor	36	38	3	5	3608·50	On sandstone ledge.
61	At N.E. cor	36	4	20	4	3411·44	On Township corner I. P.
62	"	36	28	4	5	3921·25	On I. P.
63	"	36	4	19	4	3361·61	On Township corner I. P.
64	12·54 chs. W. of Dog Pound creek, at ¼ N. of.	33	28	4	5	3839·00	On I. P.
65	At N.E. cor	36	4	18	4	3179·80	On Township corner I. P.
66	"	36	26	4	5	4214·45	On I. P.
67	17·14 chs. N. of St. Mary river, at ¼ E.	25	6	23	4	2998·94	"
68	At ¼ E.	25	25	4	5	3642·30	"
69	16·77 chs. N. of Belly river, at ¼ E.	25	8	23	4	2765·24	"
70	At N.E. cor.	36	12	25	4	3156·10	"
71	1·31 chs. W. of Belly river, at N.E. cor	35	8	22	4	2676·77	"
72	At N.E. cor	36	12	23	4	3237·25	"
73	At ¼ N. of	33	8	21	4	2978·40	"
74	At N.E. cor.	36	10	23	4	3167·80	"
75	On N.E. cor. of Lethbridge court house	31	8	24	4	2958·78	On 2nd course.
76	At N.E. cor	33	9	21	4	2906·80	On I. P.
77	At ¼ N.	33	8	24	4	2956·17	"
78	At N.E. cor	36	7	21	4	2996·85	"
79	"	34	8	26	4	3100·55	"
80	"	36	5	21	4	3190·72	"
81	By Pincer creek surveyed trail, 1·36 chs. E. of ¼ N., at N.E. cor.	33	8	26	4	3157·77	"
82	At N.E. cor	36	3	21	4	4191·30	"
83	At Sta. 52. Surveyed trail Macleod to Pincer creek.	7	7	28	4	3355·68	"
84	At N.E. cor	36	3	22	4	3697·10	"
85	At Sta. 55. Surveyed trail Macleod to Pincer creek.	12	7	29	4	3359·44	"
86	At N.E. cor	36	3	24	4	3682·48	"

SCHEDULE of Bench Marks established since June, 1894—*Continued.*

No.	Location.	Sec.	Tp.	Rge.	M.	Elevation.	Remarks.
87	At N.E. cor	36	12	28	4	3338 70	On I. P.
88	"	36	1	24	4	4068 74	"
89	"	36	2	24	4	3924 56	"
90	"	36	1	25	4	3937 84	"
91	At intake of St. Mary river canal—on S.E. ¼	36	1	25	4		" no elevation on record.
92	At N.E. cor	17	2	24	4	3823 66	On round I. P.
93	At ¼ E. of	2	4	22	4	3588 36	On I. P.
95	At N.E. cor	36	7	1	5	3753 89	"
96	" "	36	6	30	4	3619 21	"
97	" "	36	6	1	5	3854 91	" (small).
98	At ¼ E. of	12	6	1	5	4031 77	"
99	At N.E. cor	36	5	29	4	3730 15	On small I. P.
100	At intake, Bow river canal—On S.E. ¼	13	24	1	5	3364 39	On I. P.
101	At N.E. cor	10	23	29	4	3351 31	"
102	" "	36	25	28	4	3333 91	"
103	At S.E. cor.	1	23	26		3232 20	"
104	At N.E. cor.	36	24	26	4	3046 44	"
105	" "	36	25	26	4	3051·63	"
106	" "	36	23	24	4	3087 54	"
107	" "	36	24	24	4	3022 50	"
108	At C. P. Ry. N.E. of W. fence where intersected by E. Bdy	1	23	24	4	2931 00	"
109	On S. bank of Bow river, 200 feet E. of Langevin bridge	15	24	1	5	3381 16	"
110	3 ft N. of ¼ E. of	5	24	2	5	3577 40	Destroyed by bridge gang
111	25 feet N. of N. bank Fish creek, 75 feet W. of traffic bridge, on E. Bdy	4	23	1	5	3365 03	On I. P.
112	3 feet N. of Fish creek school plot (S.W. cor.) in S.E. ¼	22	22	3	5	3768 00	"
113	250 feet N.W. of N. end of traffic bridge over sheep river	29	20	29	4	3420 00	Destroyed by bridge gang
114	On line of telegraph posts—10 feet S. of 1st post N. of Nanton	21	16	28	4	3317 25	On I. P.
115	At Willow Creek—N.E cor	36	9	27	4	3139 55	"
116	At trail survey pits, W. end of St. Mary traffic bridge	23	3	25	4	3615 95	
117	At N.E. cor of	36	29	4	5	3828 49	"
118	On N. W. cor. stone of Dixon's store, Maple creek	15	11	26	3	2472 80	On cor. stone.
119	At N.E. cor	36	29	3	5	3515 76	On I. P.
120	" "	36	11	27	3	2512 98	"
121	" "	36	30	4	5	3632 92	"
122	" "	36	11	28	3	2523 66	
123	" "	36	30	3	5	3536 26	"
124	" "	36	11	29	3	2626 65	"
125	" "	36	31	4	5	3584·42	"
126	" "	36	12	29	3	2410·92	"
127	" "	36	31	3	5	3505 81	"

128	" "	36	11	1	1	2419·82	"	Eleven from Maple Creek, on C.P.Ry
						2109·55	"	" " Walsh on C.P.Ry.
129	" "	36	31	2	5	3342·37	"	
130	" "	36	10	1	4	2640·47	"	
131	At W. M. 3 chs. E. of N.E. cor	36	32	4	5	3516·21	"	
132	At N.E. cor	36	11	3	4	2464·82	"	
133	" "	36	32	3	5	3409·82	"	
134	" "	36	11	4	4	2554·71	"	
135	" "	36	32	5	5	3656·01	"	
136	" "	36	11	5	4	2464·87	"	
137	At ½ N. of	34	32	5	5	3536·03	"	
138	At N.E. corner	36	11	6	4	2345·01	On I. P.	
139	At ½ E. of	10	33	3	5	3352·21	"	
140	At N.E. corner	36	9	3	4	3252·17	"	
141	"	36	32	2	5	3321·59	"	
142	"	36	8	3	4	3980·99	"	
143	"	36	31	1	5	3227·01	"	
144	"	36	9	1	4	3088·41	"	
145	"	36	30	1	5	3247·65	"	
146	"	36	9	29	3	2950·04	"	
147	"	36	29	1	5	3247·07	"	
148	"	36	9	28	3	2878·44	"	
149	"	36	29	29	4	3120·76	"	
150	"	36	9	27	3	2904·15	"	
151	"	36	29	28	4	3217·69	"	
152	"	36	9	26	3	3154·81	"	
153	"	36	28	27	4	3113·18	"	
154	"	36	9	25	3	3519·03	"	
155	"	36	27	27	4	3039·80	"	
157	"	36	26	27	4	3038·80	"	
159	"	36	25	27	4	3093·85	"	
200	21 chs. N. of N.E. cor. (on N. side of large lake)	36	1	28	4	4558·28	On solid I. P.	
201	At N.E. corner	36	1	29	4	4870·70	"	
252	On E. side of trail just N. of Middle Waterhen lake	25	1	30	4	4179·32	"	
260	8·26 chs. S. of N.E. corner	13	8	3	4	4553·30	On I. P.	
261	At N.E. corner	36	7	2	4	4600·63	"	
262	22 chs. S. of N.E. cor	13	5	3	4	3712·27	"	
263	5 chs. E. of ½ N	34	4	2	4	3552·93	"	
264	34·27 chs. E. of N.E. cor	31	4	1	4	No elev'tion	"	
265	142 ft. N. of a point 5 chs. E. of ½ N	35	4	30	3	3349·56	"	
266	At N.E. corner	34	4	27	3	3074·11	"	
267	"	36	4	26	3	3054·86	"	
268	11 chs. E. of S.E. cor	3	7	25	3	3532·84	"	
269	At N.E. corner	36	7	23	3	3776·64	"	
270	45·92 chs. W. of N.E. cor	36	7	25	3	3882·65	"	
271	8 ft. S. of a point 22 chs. W. of N.E. corner	34	7	27	3	4126·49	"	
272	At N.E. corner	34	7	29	3	4381·51	"	
273	At intake of Whitemud canal N.W. ¼ of	21	6	24	3	3118·81	"	
274	3·50 chs. N. of N.E. cor	36	8	23	3	3767·86	"	
276	1 ch. N. of a point 35 chs. W. of N.E. cor	2	10	24	3	3573·03	"	

SCHEDULE of Bench Marks established since June, 1894—*Concluded.*

No.	Location.	Sec.	Tp.	Rge.	M.	Elevation.	Remarks.
277	At N.E. cor	36	9	20	4	2784 02	"
278	"	36	9	18	4	2668 91	"
279	"	36	7	19	4	3034 20	"
280	"	36	6	16	4	3053 83	"
281	"	36	7	17	4	2961 69	"
301	100 ft. E. of N.E. cor	36	26	25	4	2981 07	"
302	At S.E. cor. of	1	23	25	4	3051 77	"
303	At N.E. cor. of	36	25	24	4	2807 96	"
304	"	36	27	25	4	2967 47	"
305	"	36	26	24	4	3077 49	"
306	"	36	27	23	4	2913 13	"
307	At S.E. cor	1	23	23	4	3085 38	"
308	"	1	23	22	4	2959 50	"
309	At N.E. cor	36	24	22	4	2842 54	"

PHOTO-TOPOGRAPHICAL SURVEYS.

Owing to the broken and rugged character of that portion of the semi-arid district comprised within the foothills region and the eastern slope of the Rocky Mountains, it was found that a different system to that previously outlined for effecting the topographical surveys in the plains region would be necessary in completing the contour survey of this area, and in 1895 it was decided to meet the special conditions in that portion of the semi-arid region by adopting a primary system of triangulation throughout the district as a basis for a photo-topographical survey of that region.

The introduction of photography in connection with topographical surveys in Canada is due to Mr. E. Deville, Surveyor-General of Dominion Lands, he having elaborated and brought to a practical working basis the systems for utilizing photography in surveys of this kind which had previously been used both in France and Italy.

Prior to the introduction of this class of survey in connection with our irrigation work, surveys of a portion of the Rocky Mountains adjacent to the Canadian Pacific Railway in Alberta and through British Columbia had been completed and mapped.

The photo-topographical surveys in the semi-arid region were commenced in the vicinity of the Bow river, and extended south, covering the foothills region and the eastern slope of the Rocky Mountains to the northern end of the Porcupine Hills. These surveys were continued during the seasons of 1897 and 1898, and some thousands of square miles of country which it would have been almost impossible to have properly surveyed and mapped by any of the ordinary processes of topographical surveying, were covered by these photo-topographical surveys, and it is hoped in the near future to be able to issue a series of contour maps covering this district, which will be of value as indicating the character of the country in what is practically the main watershed of the semi-arid region.

HYDROGRAPHIC SURVEYS.

The extent and permanency of irrigation development in the semi-arid region are dependent entirely upon the supply of water which it is possible to divert from its natural channels and utilize in irrigating crops. It is, therefore, of first importance that some reliable data should be obtained as to the location and quantity of such water supply, and our hydrographic surveys have that end in view.

To ascertain with even a fair degree of accuracy the volume of the available water supply entails investigations which may be summarized under the following heads:—

(a) The measurement of the daily discharge of streams.

(b) The measurement of the volume of water in lakes, marshes and swamps.

(c) The measurement of the discharge of springs.

(d) The determination of the rate of evaporation under varying conditions.

To obtain accurate data upon which to base deductions under the above headings, it is evident that our observations will have to extend over a series of years, and that the observations must be accurately and regularly made.

The methods adopted in dealing with this branch of the work, varied in some minor details to suit particular circumstances, are as follows:—

All the streams within the semi-arid region are carefully numbered at different points in their length to determine the cross-section of the channel at the different stages of low water, high water and flood discharge, and the actual discharge of water at time of measurement is determined by use of current inches to measure the velocity of the stream.

Having determined the actual discharge at the date of measurement, sufficient data as to the general slope of the bed of the stream and its character is obtained, and the probable discharge at the different stages of high water and flood stages is then calculated by use of Kutter's well known formula for the flow of water in open channels.

These results, however, are only of use as a basis for approximate figures regarding the available water supply from streams, for in the absence of information as to the rise and fall of the streams, and the duration of the flow at any particular height of water, it is impossible to give a correct estimate of the daily, monthly or annual discharge of the streams.

We have therefore endeavoured to supplement the isolated measurements of the discharge of streams by keeping a record of their rise and fall, so that the daily and mean annual discharges may be computed. This is done by establishing a gauge which will show from inspection the stage of water at any time. These gauges are of two different kinds. On the smaller streams they consist of a rod suitably divided in feet and tenths, and placed on some permanent structure in the stream. The height of water on this rod is read daily, and the observations entered on proper forms so as to show the daily range in water elevation.

On the larger streams self-recording instruments are used to provide the same information.

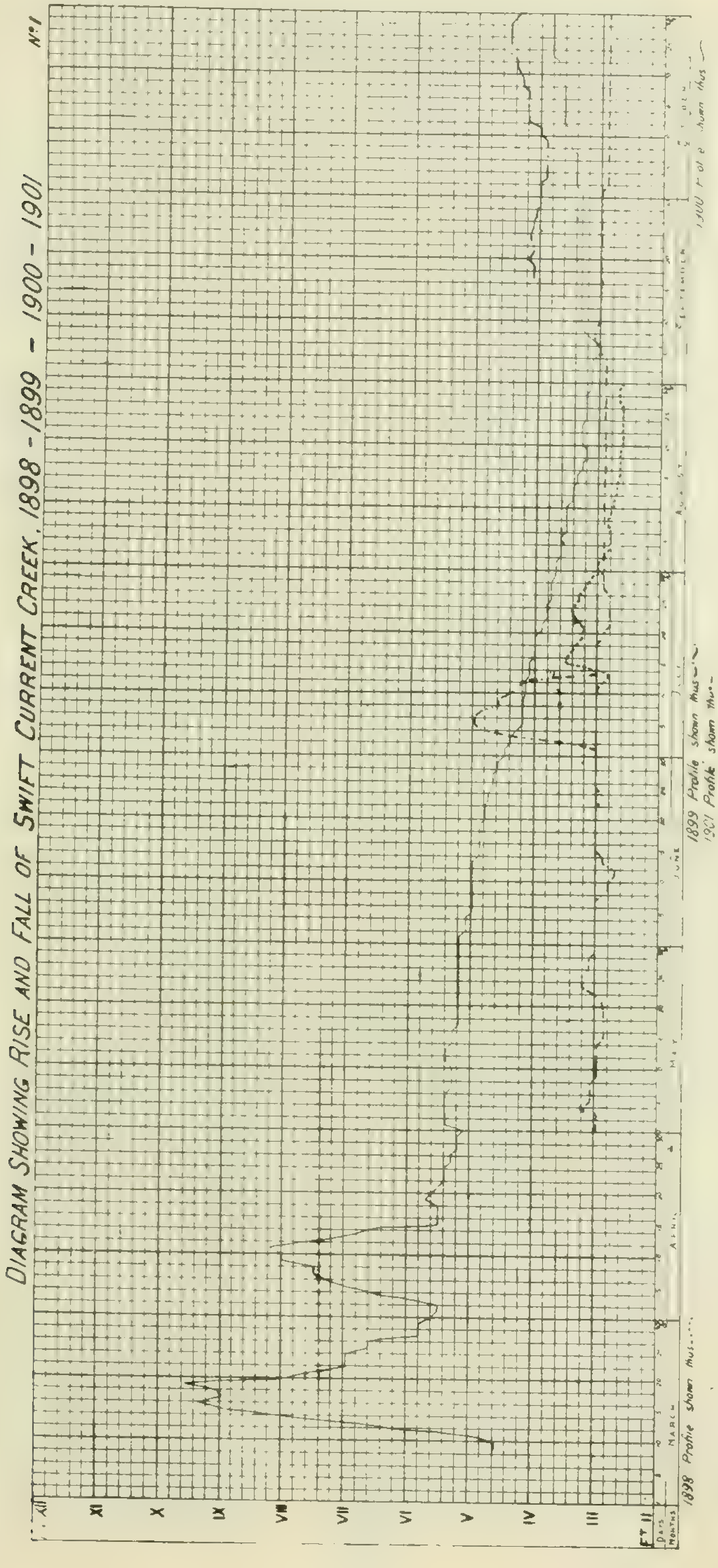
The streams which are being dealt with on the basis of rise and fall are shown on the accompanying schedule.

SCHEDULE of Hydrographs, Nilometers and Gauge Rods.

Name of Stream.	Name of Bridge.	Location.
Hydrographs		
Bow river	Langevin	Calgary.
St. Mary river		Half mile above intake of C.N.W. Irrigation Co's canal.
Nilometers		
Elbow river	Mission	Near Calgary.
Highwood river	Traffic	High river.
Oldman river	"	Near Macleod.
Gauge Rods—		
Bow river	Langevin	Calgary.
Elbow river	Mission	Near Calgary.
Fish creek	Traffic	Near Midnapore.
Highwood river	"	At High river.
Jumping pound creek	"	On Morleyville trail.
Oldman river	"	Near Macleod
Pincer creek	"	At Pincer creek.
Belly river	"	At Lethbridge.
St. Mary river	At N.W.M.P. detachment	At Colles.
St. Mary river		Half mile above intake of C.N.W Irrigation Co's canal.
Nose creek	On C. & E. railway bridge	East of Calgary.
Sheep river	" "	Near Okotoks.
Mosquito creek	" "	Near Nanton.
Willow creek	" "	Near Macleod.
Seven Person's creek	On C. P. railway bridge	Near Medicine Hat.
Bullshead creek	" "	Near Dunmore Junction.
Ross creek	" "	Near Irvine.
MacKay creek	" "	Near Walsh.
Boxelder creek	" "	Near Walsh.
Gap creek (Fish creek)	" "	Near Maple creek.
Maple creek	" "	At Maple creek.
Hay creek	" "	Near Maple creek.
Piapot creek	" "	Near Colley.
Swift current creek	" "	Near Swift Current.

DIAGRAMS.

The accompanying diagrams illustrate in graphic form the range of flow in the streams upon which gauge rod or nilometer records have been taken.


No. 1
DIAGRAM SHOWING RISE AND FALL OF SWIFT CURRENT CREEK, 1898 - 1899 - 1900 - 1901
1898 Profile shown thus
1899 Profile shown thus
1901 Profile shown thus
1900 Profile shown thus
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
DAYS
MONTHS
FT. II
III
IV
V
VI
VII
VIII
IX
X
XI
XII

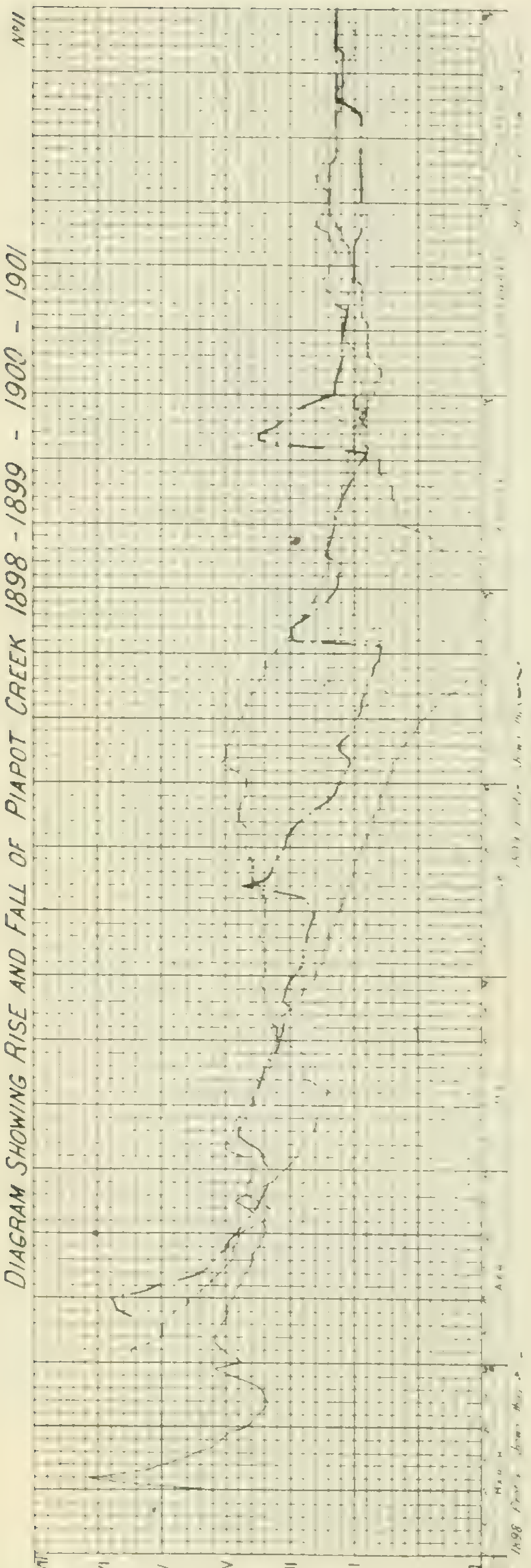


DIAGRAM SHOWING RISE AND FALL OF PIAPOT CREEK 1898 - 1899 - 1900 - 1901
No II
FT VII
VI
V
IV
III
II
I
FT O

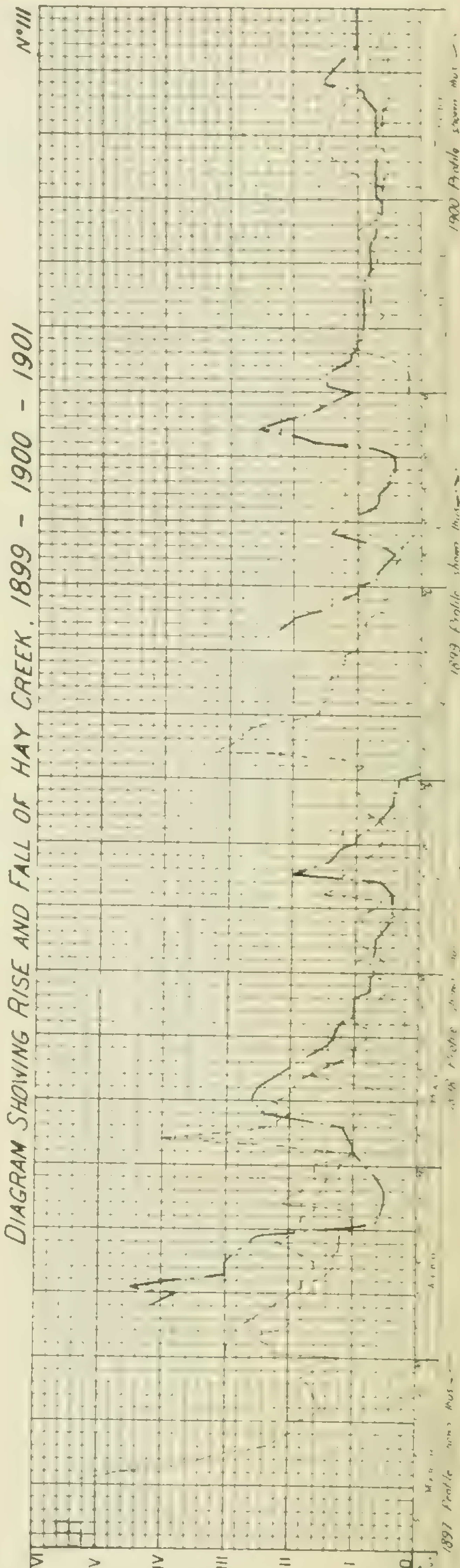


DIAGRAM SHOWING RISE AND FALL OF HAY CREEK, 1899 - 1900 - 1901
No III
FT VI
V
IV
III
II
I
FT O

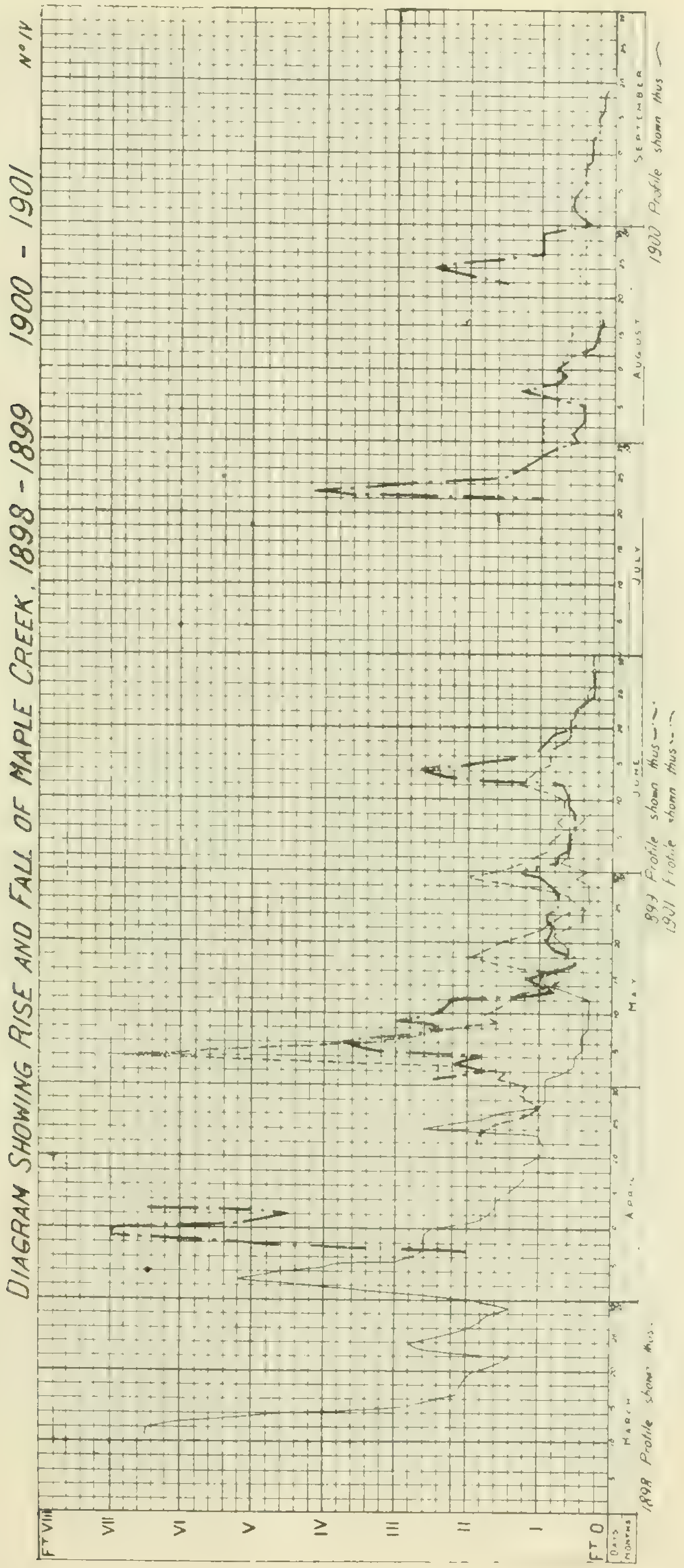


DIAGRAM SHOWING RISE AND FALL OF MAPLE CREEK, 1898 - 1899 1900 - 1901
No IV
FT VIII
VII
VI
V
IV
III
II
I
FT 0
DAYS
MONTHS
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
1898 Profile shown thus.
1899 Profile shown thus
1901 Profile shown thus
1900 Profile shown thus

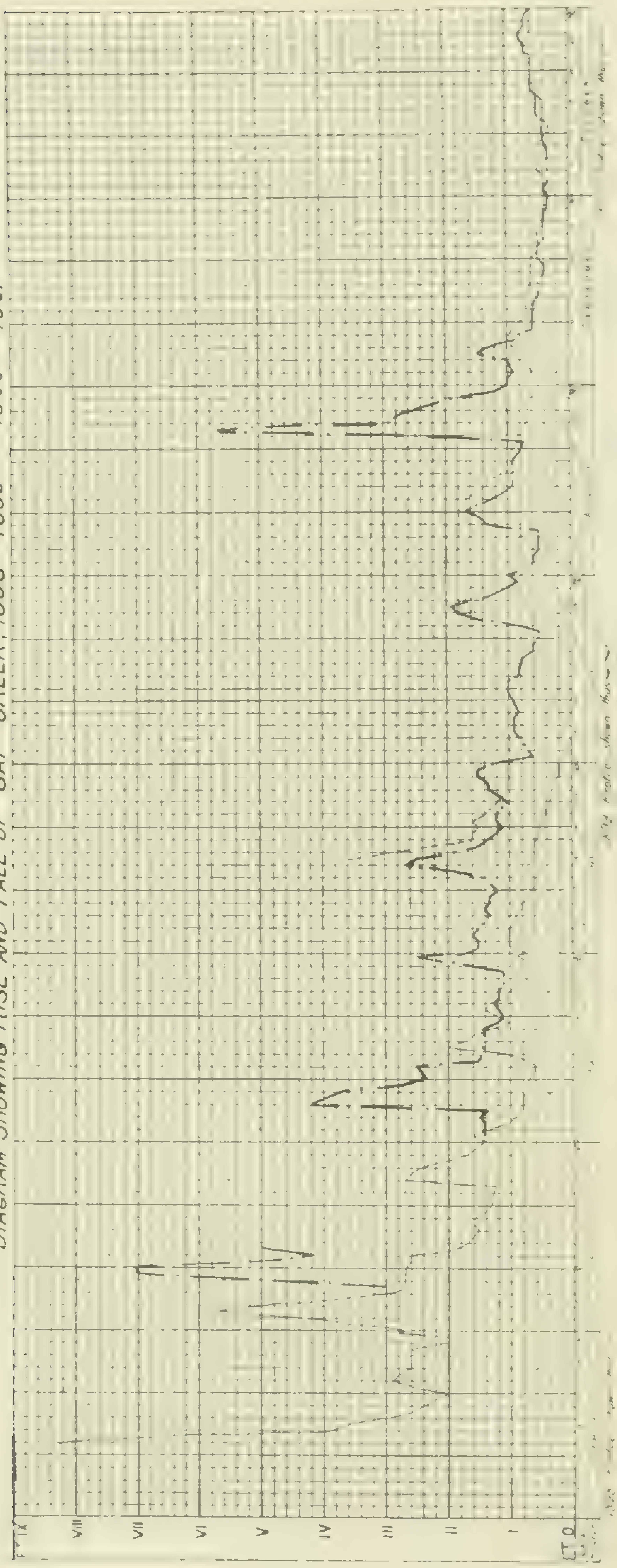
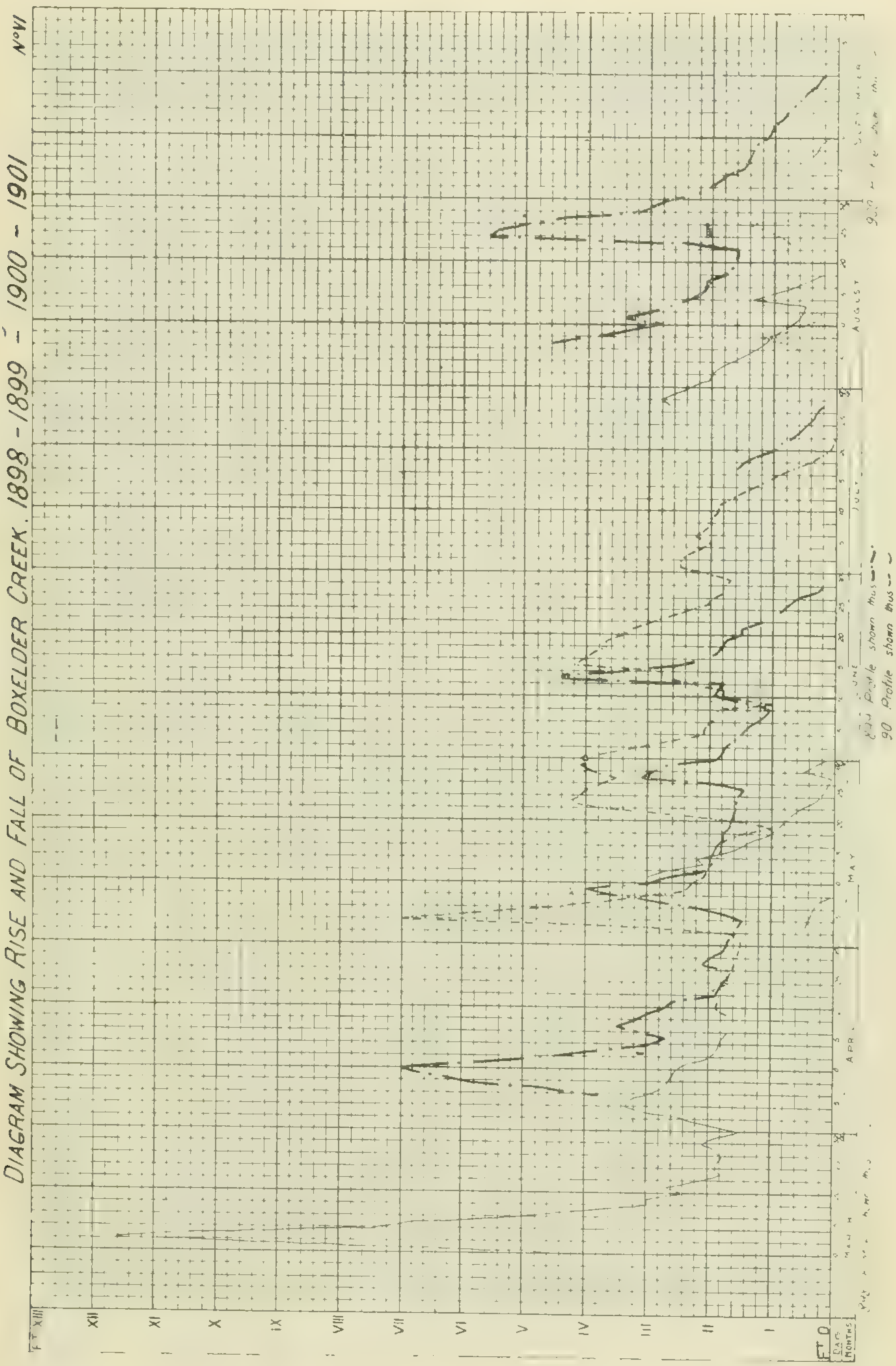


DIAGRAM SHOWING RISE AND FALL OF GAP CREEK, 1898 - 1899 - 1900 - 1901


N°VI
DIAGRAM SHOWING RISE AND FALL OF BOXELDER CREEK. 1898 - 1899 - 1900 - 1901
APR.
MAY
JUNE
JULY
AUGUST
90 Profile shown thus
MONTHS

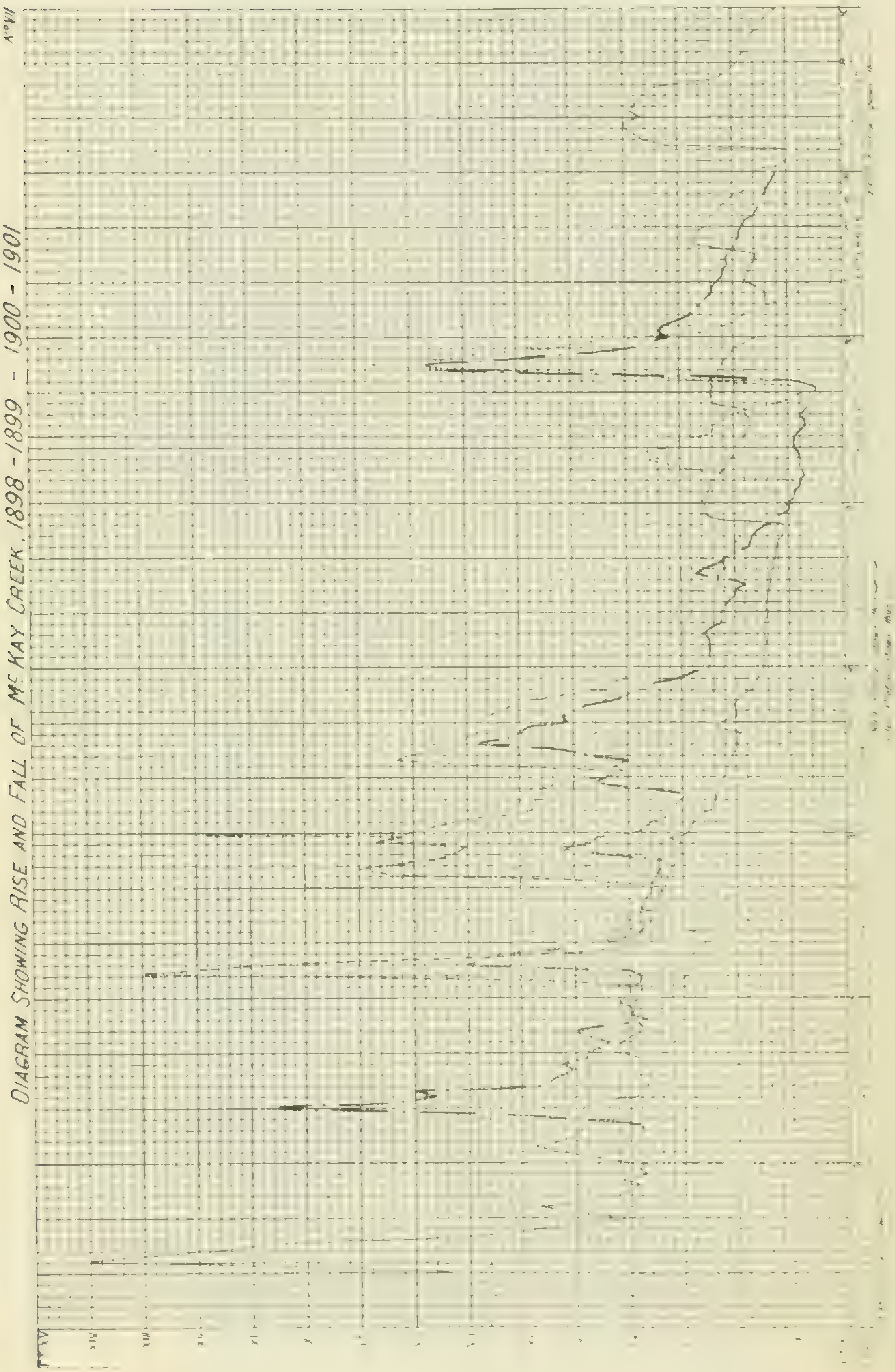
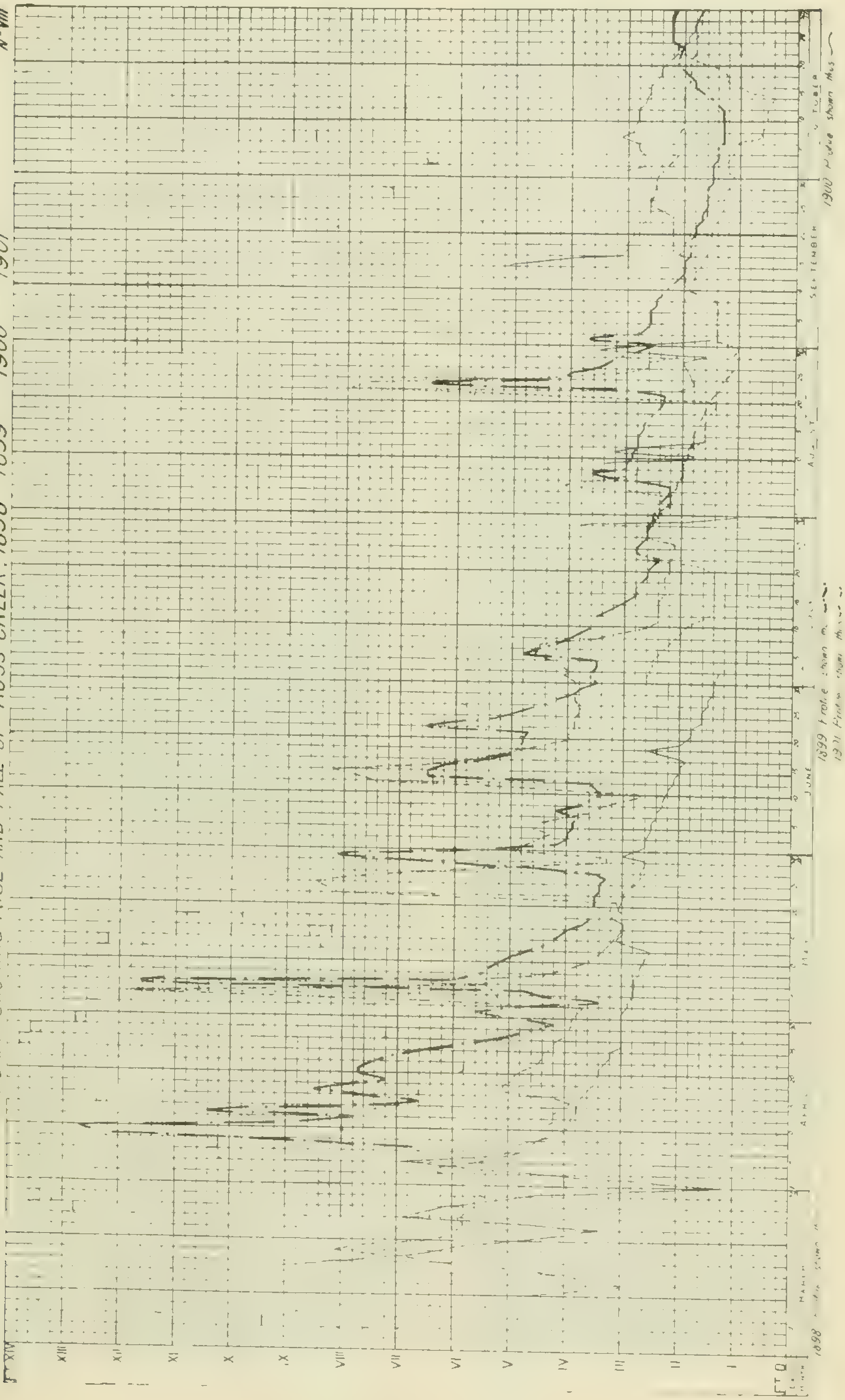


DIAGRAM SHOWING RISE AND FALL OF Mc KAY CREEK, 1898 - 1899 - 1900 - 1901
No VII

DIAGRAM SHOWING RISE AND FALL OF ROSS CREEK, 1898-1899-1900-1901



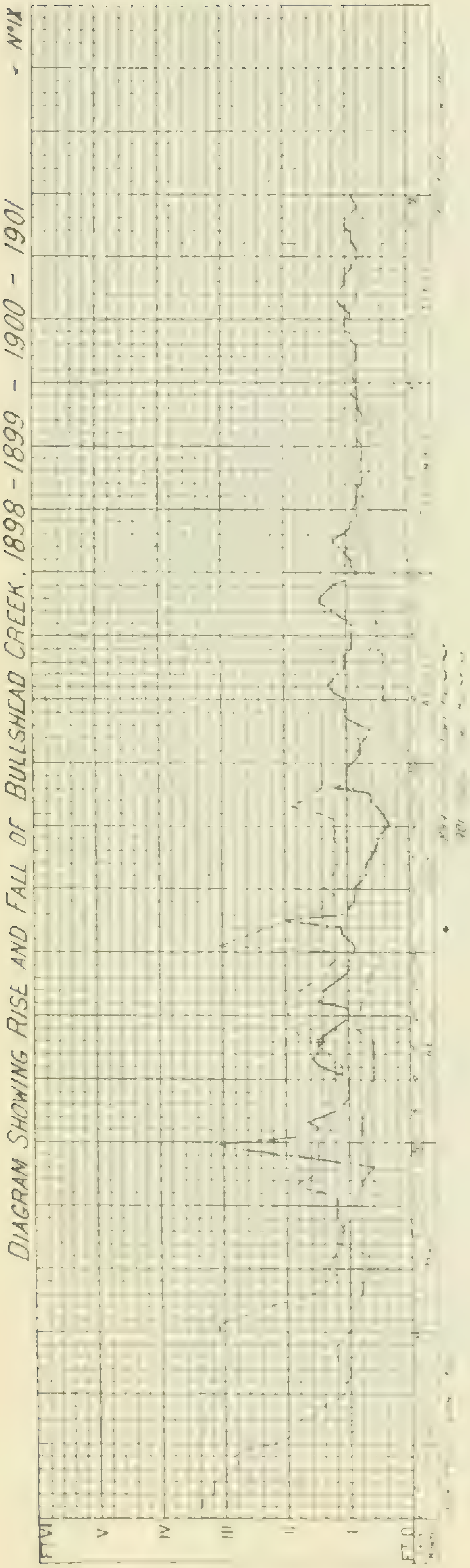


DIAGRAM SHOWING RISE AND FALL OF BULLSHEAD CREEK, 1898 - 1899 - 1900 - 1901
No IX
VI
V
IV
III
II
I
0

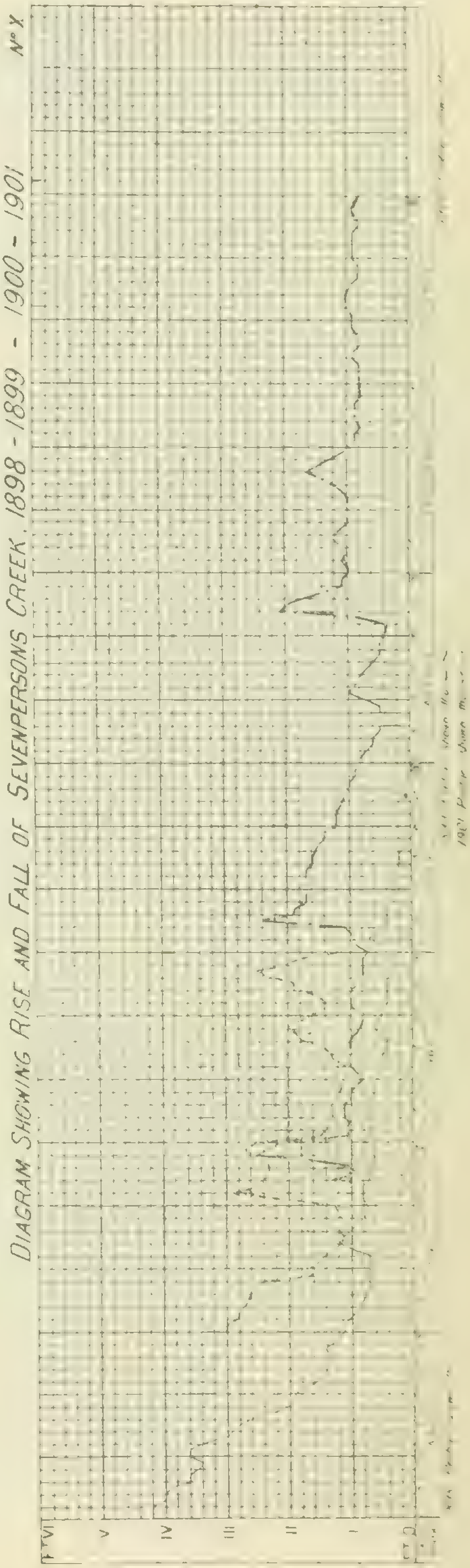
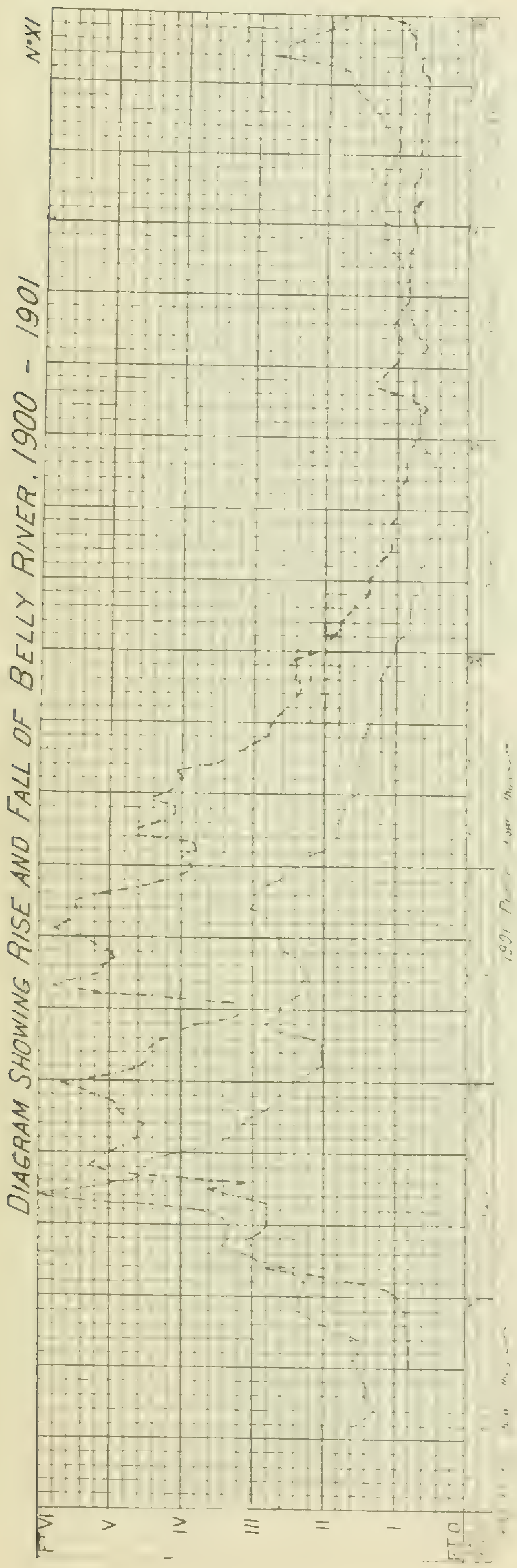
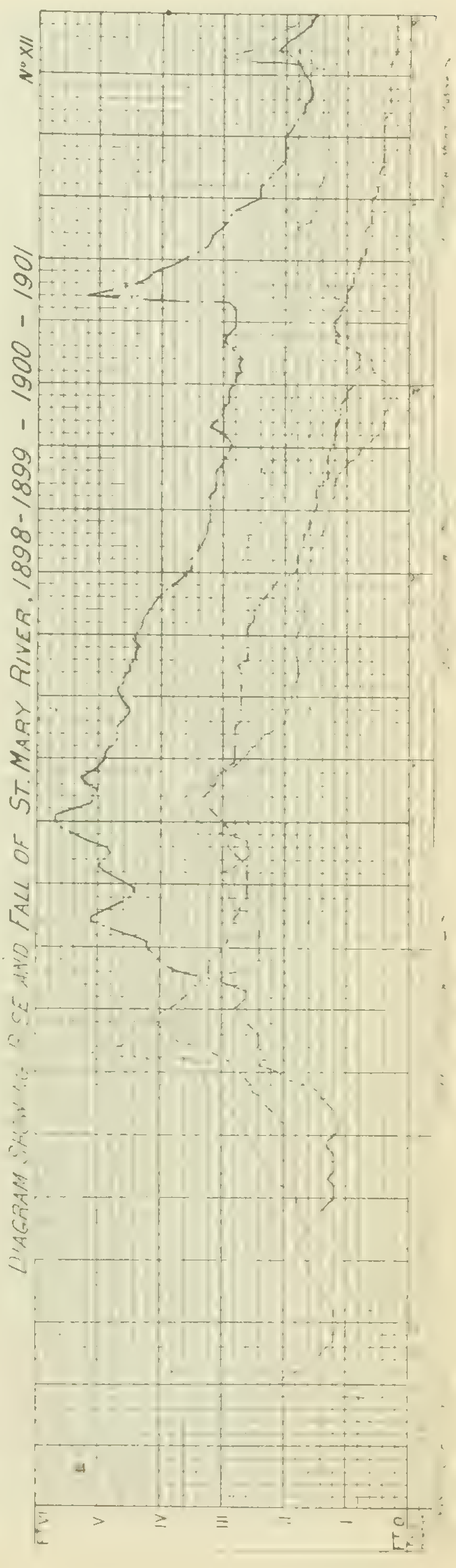


DIAGRAM SHOWING RISE AND FALL OF SEVENPERSONS CREEK, 1898 - 1899 - 1900 - 1901
No X
VI
V
IV
III
II
I
0


N°XI
DIAGRAM SHOWING RISE AND FALL OF BELLY RIVER, 1900 - 1901
FT VI
V
IV
III
II
I
FT 0


N°XII
ST. MARY RIVER, 1898-1899 - 1900 - 1901
FT VI
V
IV
III
I
FT 0

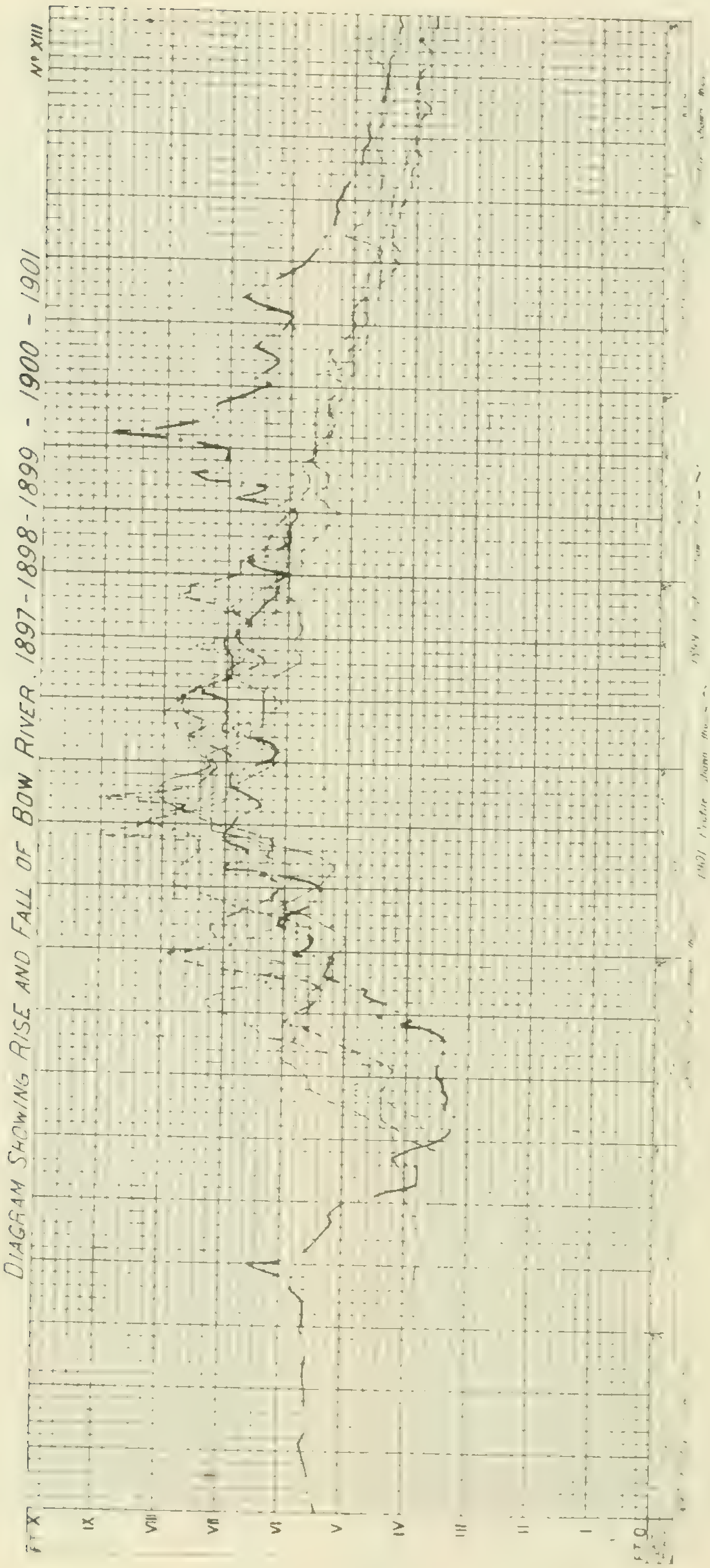
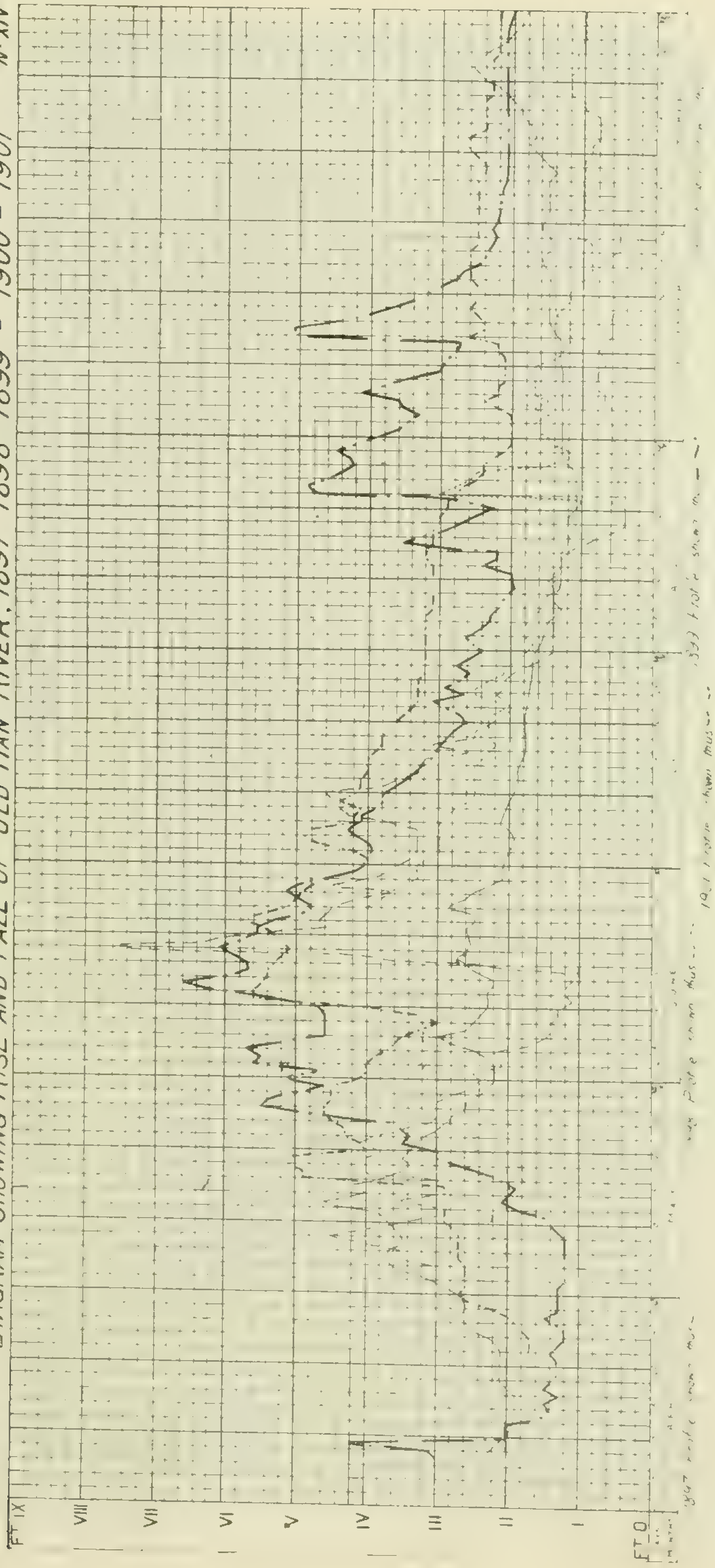


DIAGRAM SHOWING RISE AND FALL OF BOW RIVER. 1897-1898-1899-1900-1901
No XIII
FT X
IX
VIII
VII
VI
V
IV
III
II
I
FT 0

SESSIONAL PAPER No. 25a

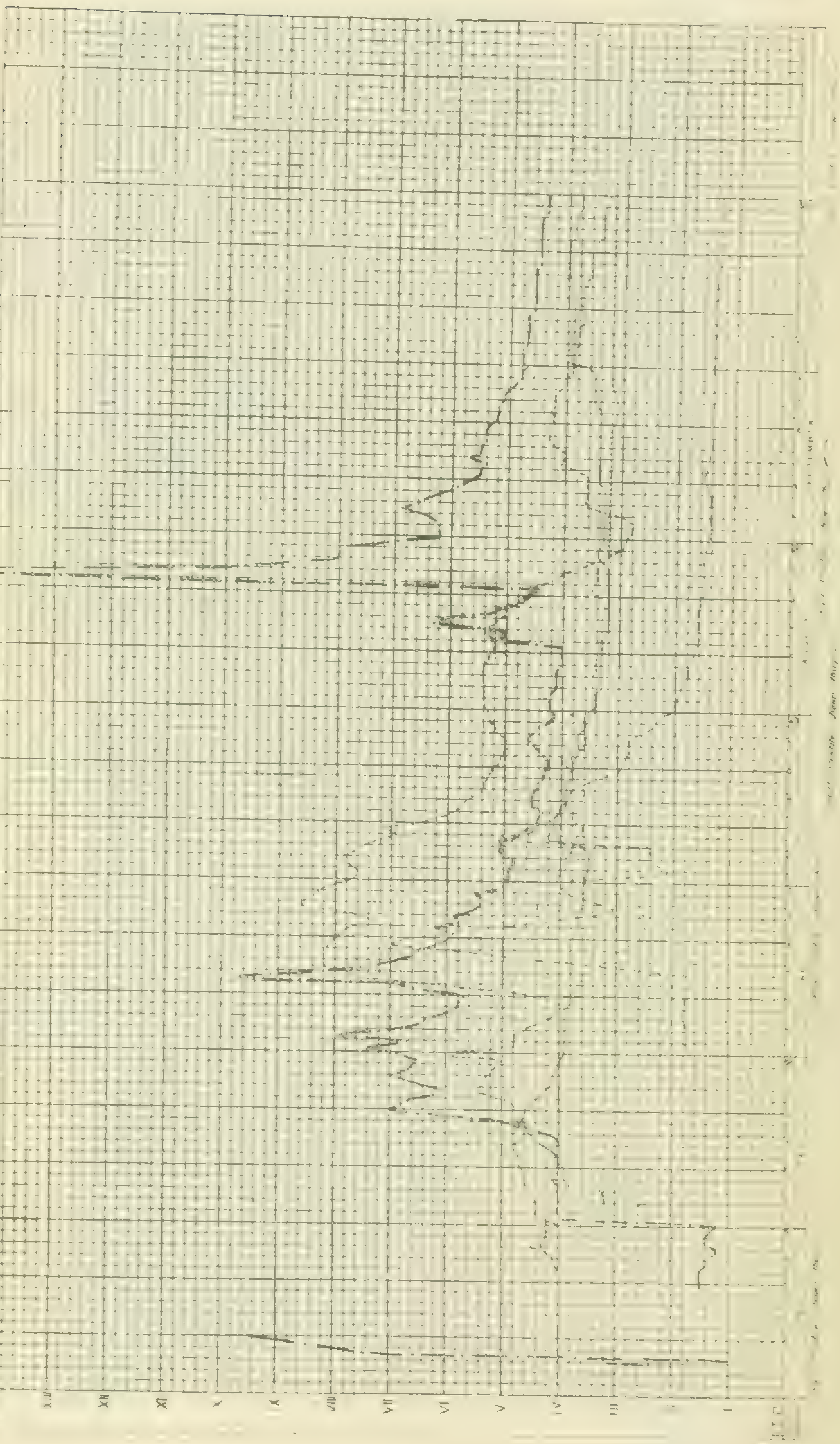
DIAGRAM SHOWING RISE AND FALL OF OLD MAN RIVER, 1897-1898-1899 - 1900 - 1901

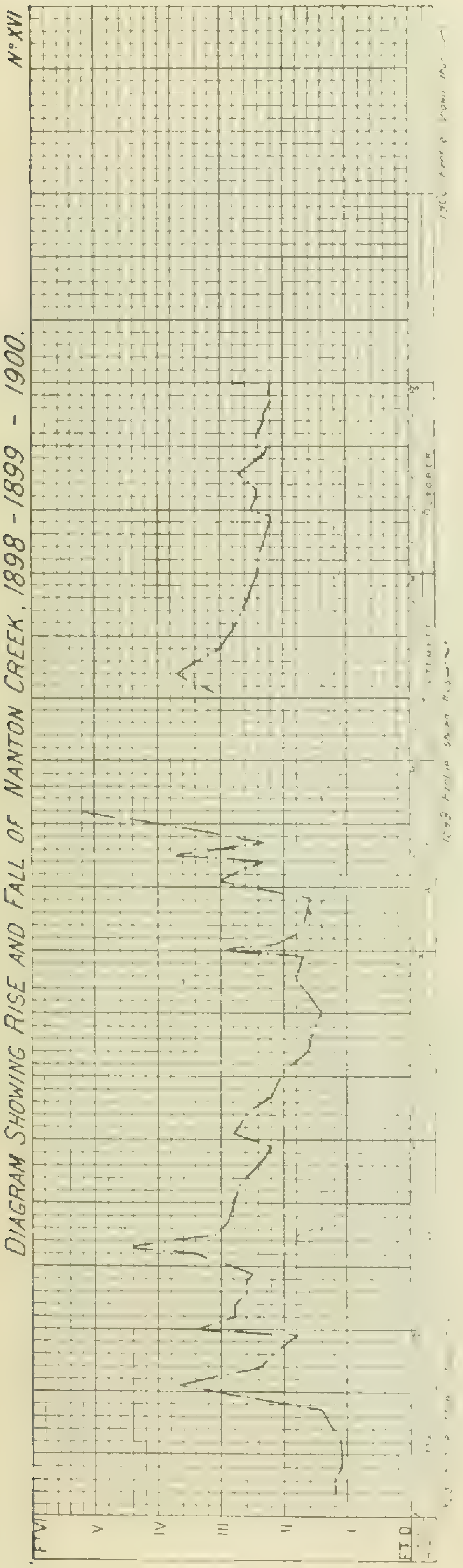
N° XIV



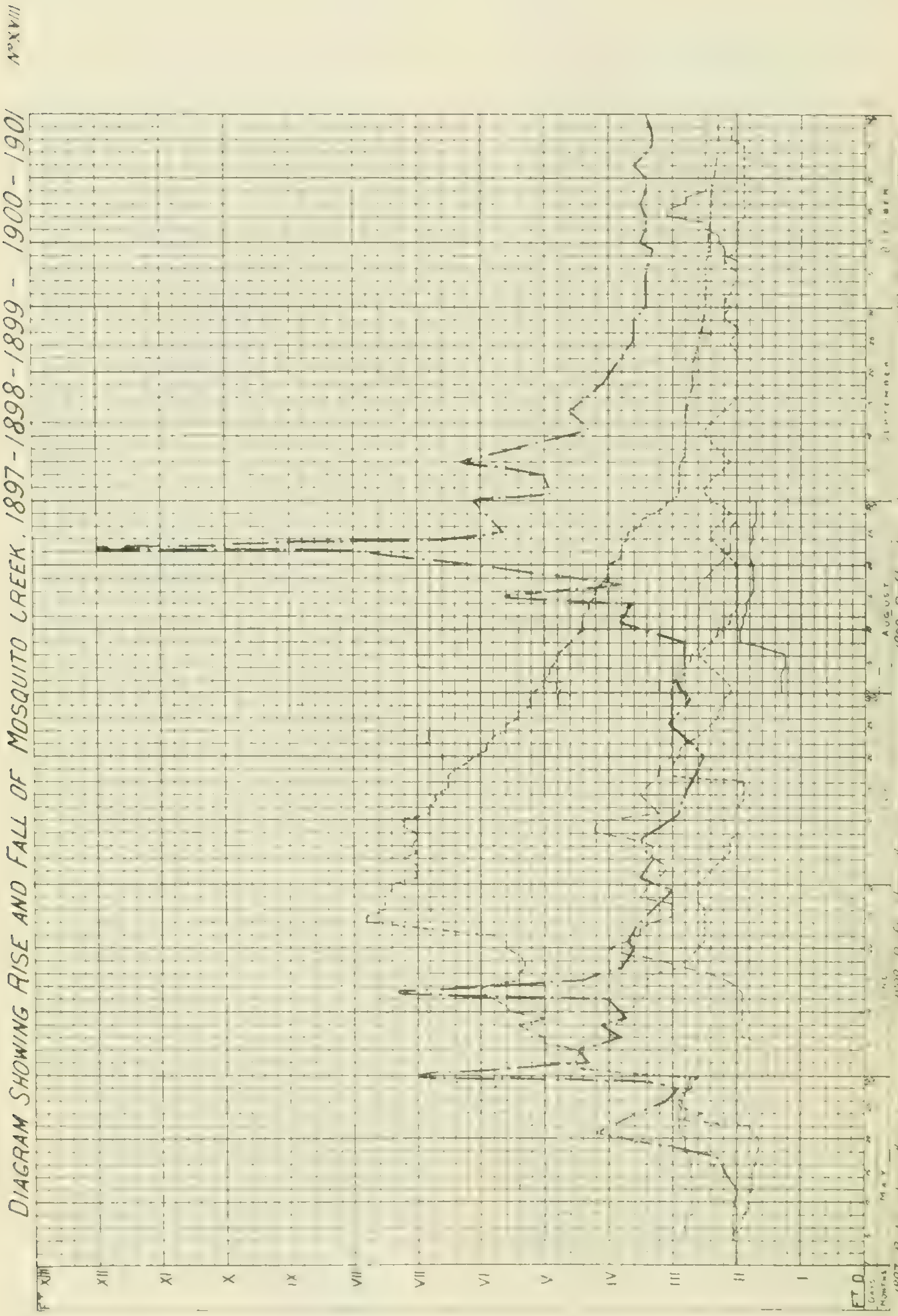
N° XV

DIAGRAM SHOWING RISE AND FALL OF WILLOW CREEK, 1897 - 1898 - 1899 - 1900 - 1901




No XVI
DIAGRAM SHOWING RISE AND FALL OF NANTON CREEK, 1898 - 1899 - 1900.
FT VI
V
IV
III
II
I
FT O

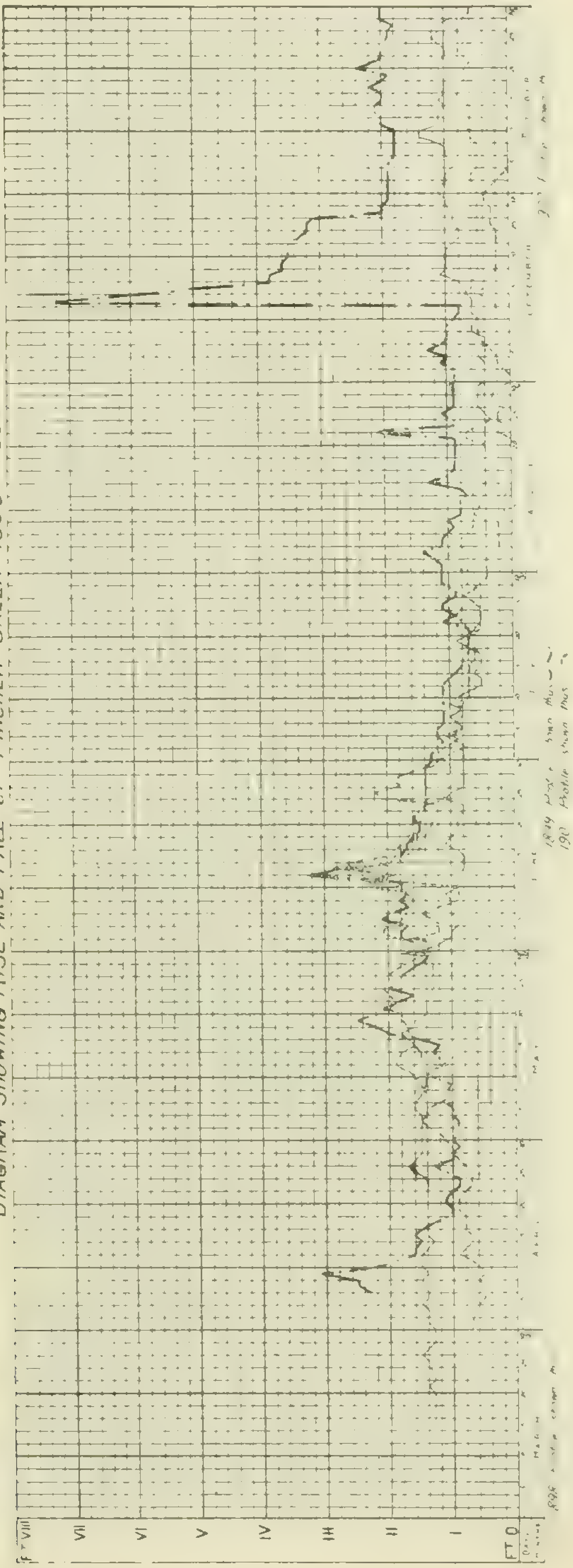

No XVII
DIAGRAM SHOWING RISE AND FALL OF FISH CREEK, 1897 - 1898 - 1899 - 1900.
FT VI
V
IV
III
II
I
FT O


N° XVIII
DIAGRAM SHOWING RISE AND FALL OF MOSQUITO CREEK. 1897-1898-1899-1900-1901
1899 Profile shown thus
1898 Profile shown thus
AUGUST
MAY
XIII
XII
XI
X
IX
VIII
VII
VI
V
IV
III
II
I
F.T. 0

SESSIONAL PAPER No. 25a

N° XIX

DIAGRAM SHOWING RISE AND FALL OF PINCHER CREEK 1898 - 1899 - 1900 - 1901



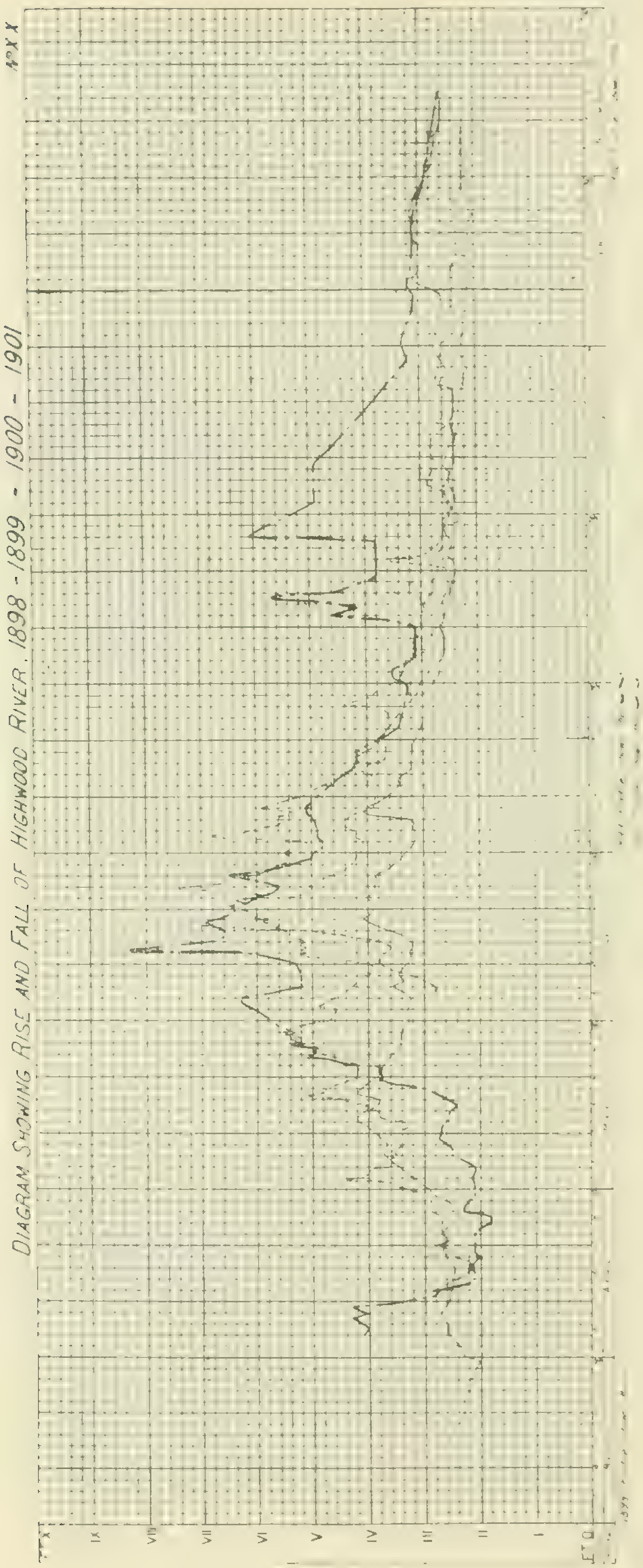
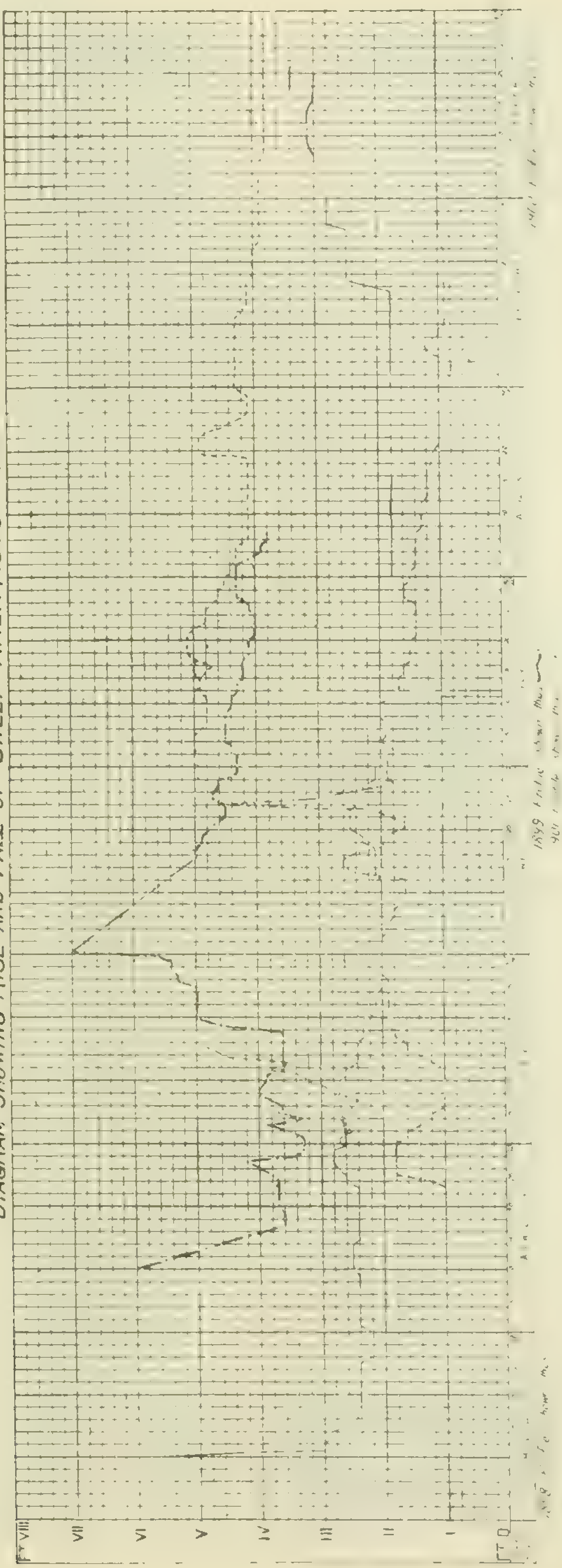
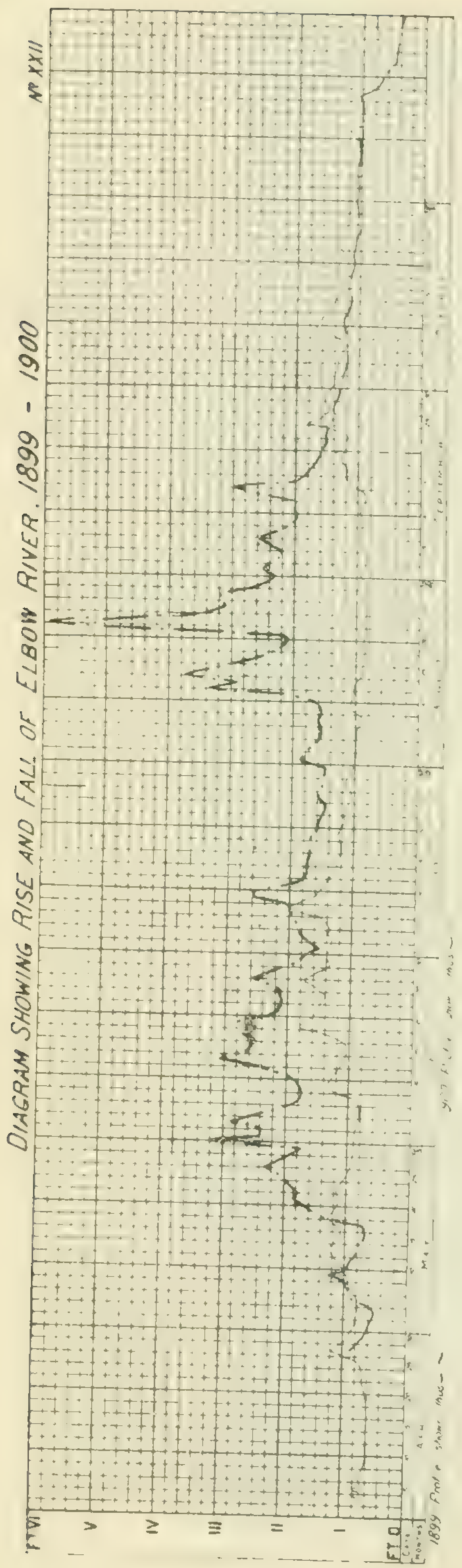


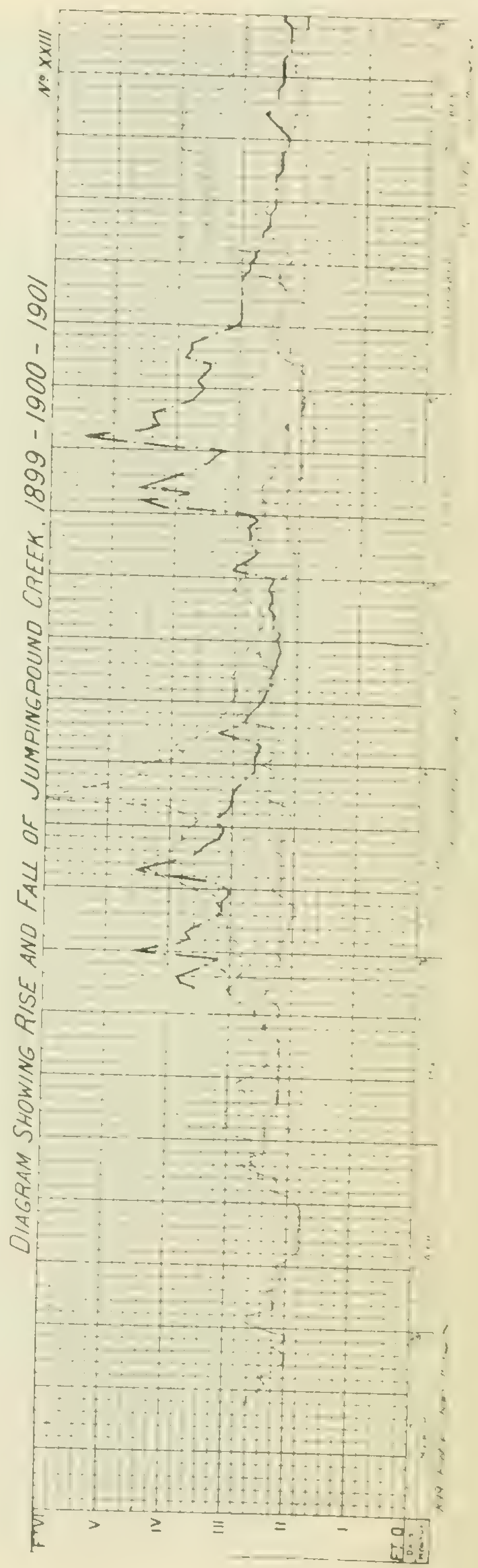
DIAGRAM SHOWING RISE AND FALL OF HIGHWOOD RIVER. 1898 - 1899 - 1900 - 1901

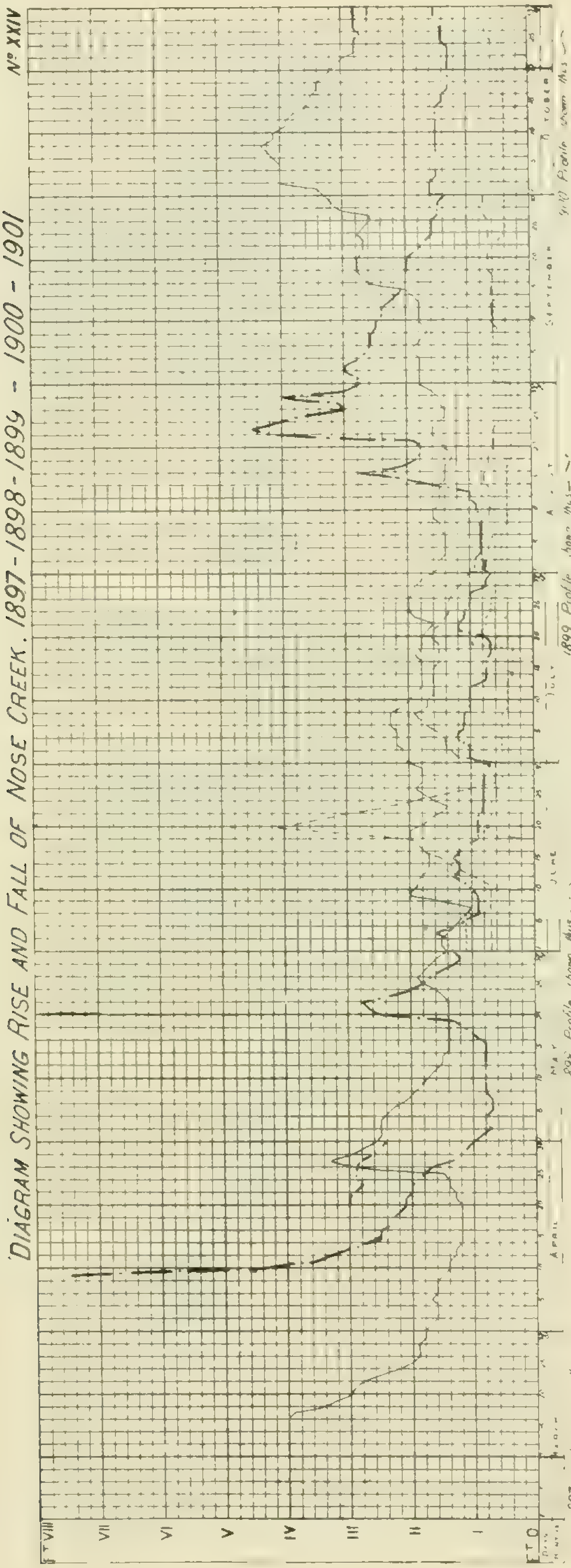
No. XXI

DIAGRAM SHOWING RISE AND FALL OF SHEEP RIVER. 1898 - 1899 - 1900 - 1901




No. XXII
DIAGRAM SHOWING RISE AND FALL OF ELBOW RIVER, 1899 - 1900
FT. O
I
II
III
IV
V
FT. VI


No. XXIII
DIAGRAM SHOWING RISE AND FALL OF JUMPINGPOUND CREEK, 1899 - 1900 - 1901
FT. O
I
II
III
IV
V
FT. VI


No XXIV
DIAGRAM SHOWING RISE AND FALL OF NOSE CREEK. 1897-1898-1899 - 1900 - 1901
1899 Profile
1901 Profile shown thus
VIII
VII
VI
V
IV
III
II
I
O

RESERVOIRS.

The possibility of using the total quantity of water available for irrigation is dependent upon the facilities provided for storing the flow of the streams during periods of flood. Part of the work of the general irrigation surveys has, therefore, been the location of such sites as might be utilized as reservoirs for the storage of the flood and high water discharge of the streams until required for irrigating adjacent areas.

The reservoirs which have so far been located are shown by the accompanying sketch plans.

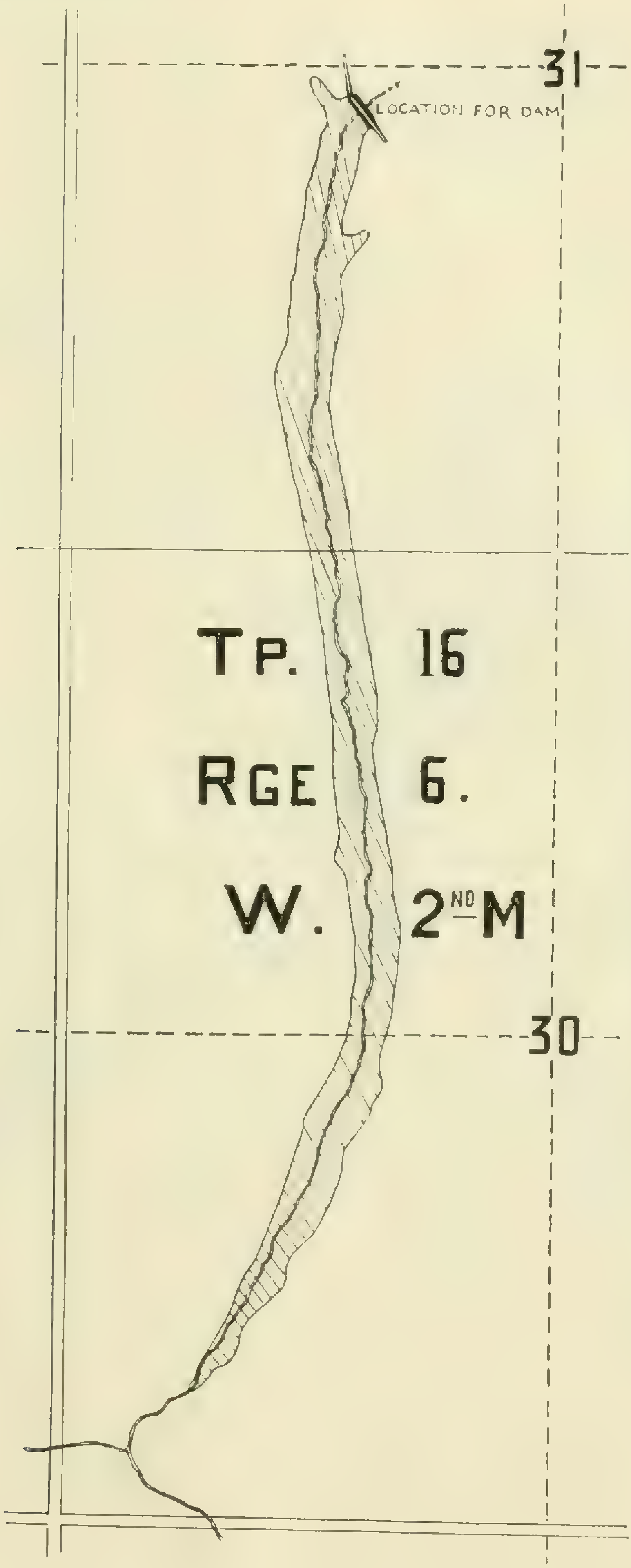


FIG. 1.—RESERVOIR SITE ON TRIBUTARY OF ECAPO CREEK.

Fig. 2. RESERVOIR SITE ON REDFOX CREEK.

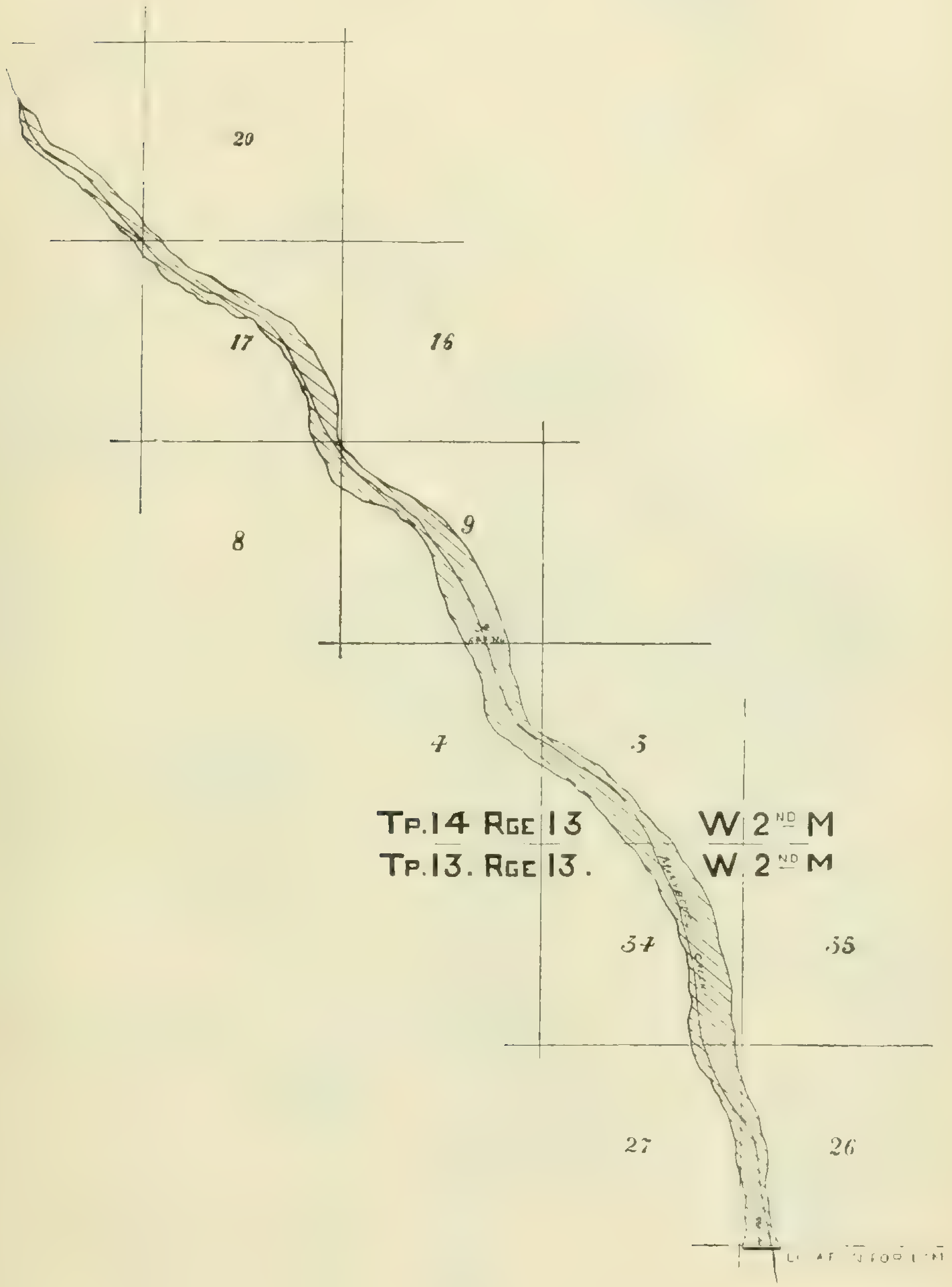


FIG. 3—RESERVOIR SITE ON MANYBONES CREEK.

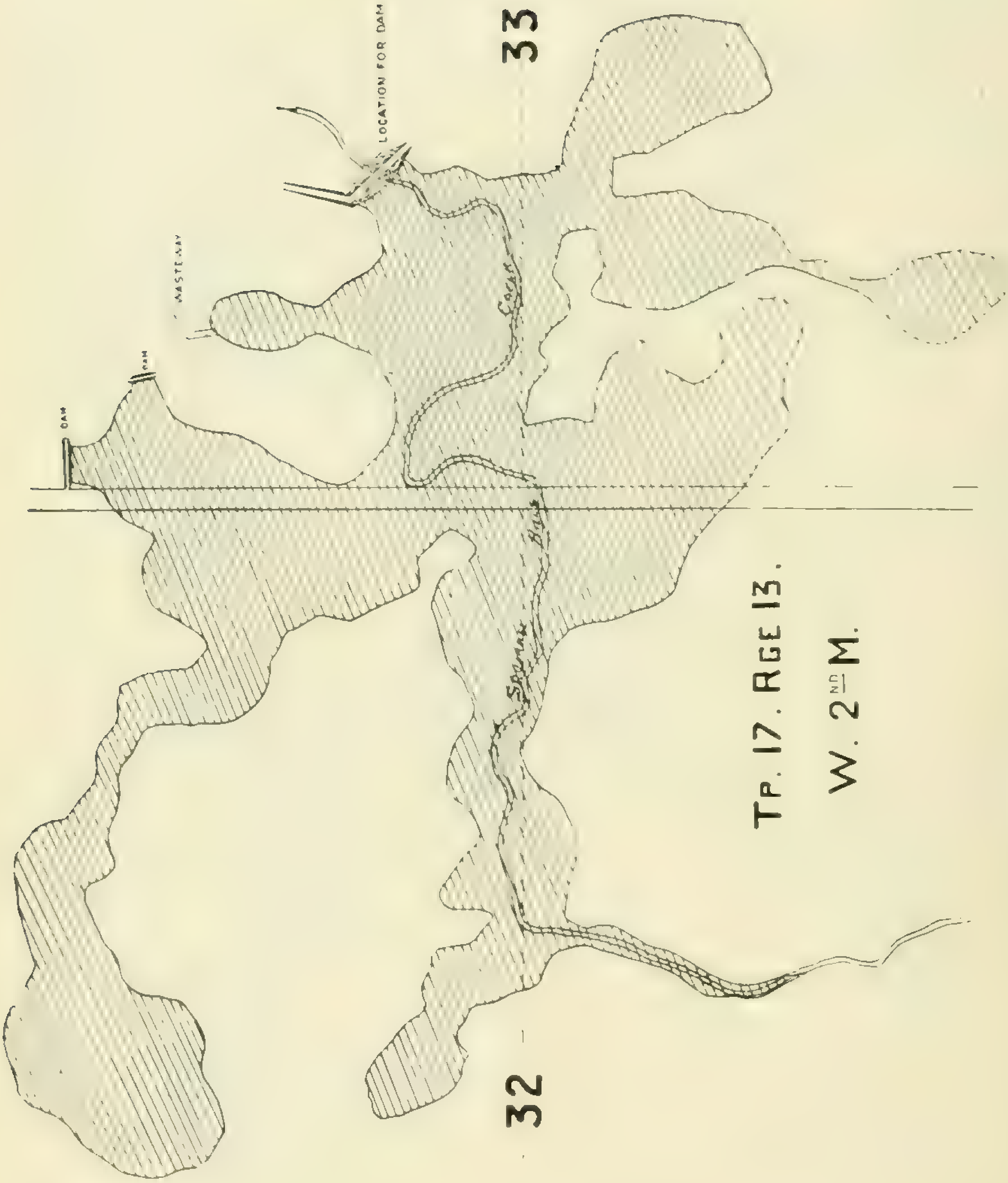


FIG. 4.—RESERVOIR SITE ON SQUIRREL HILLS CREEK.

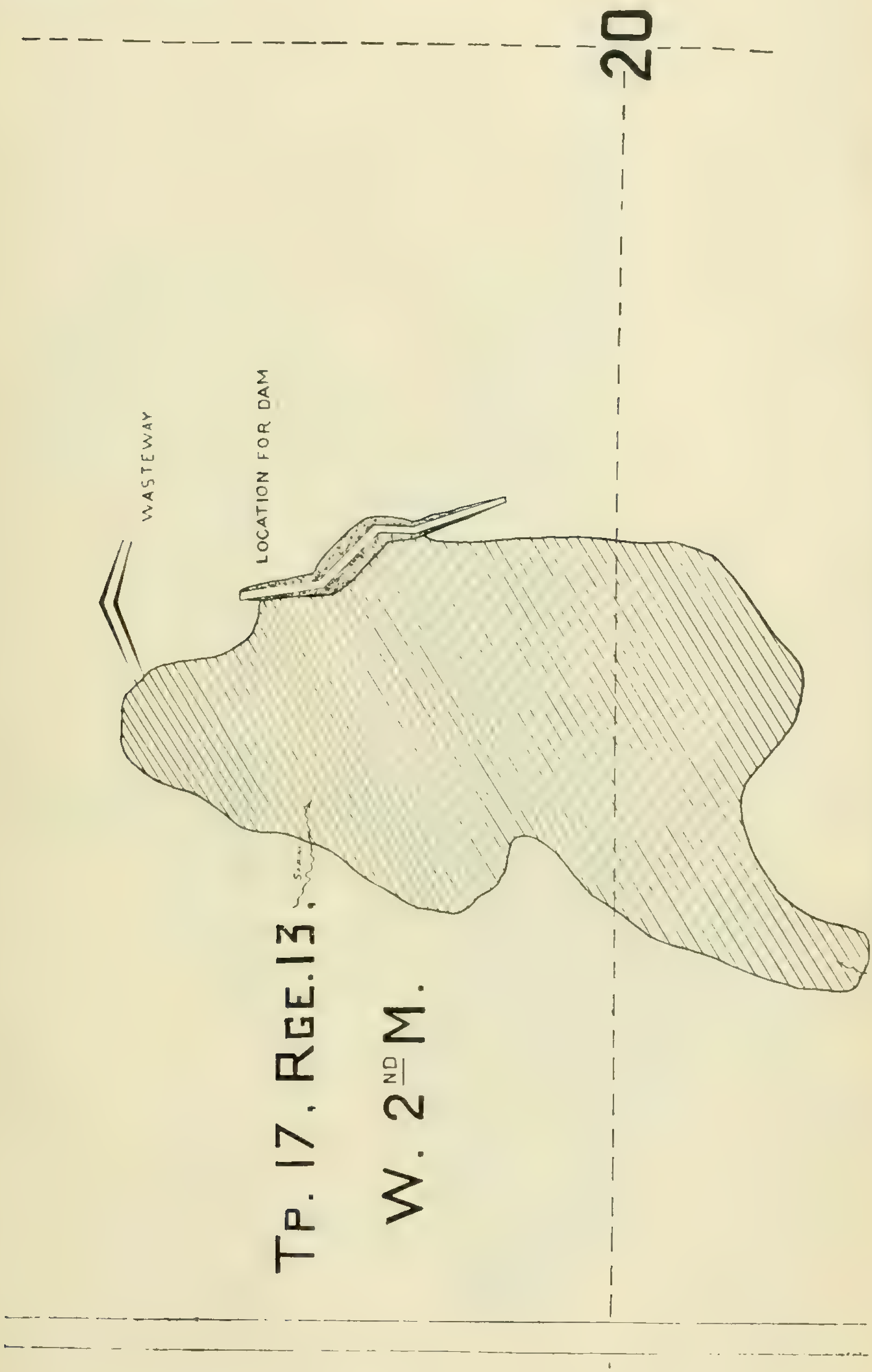


FIG. 5.—RESERVOIR SITE ON SQUIRREL HILLS CREEK.

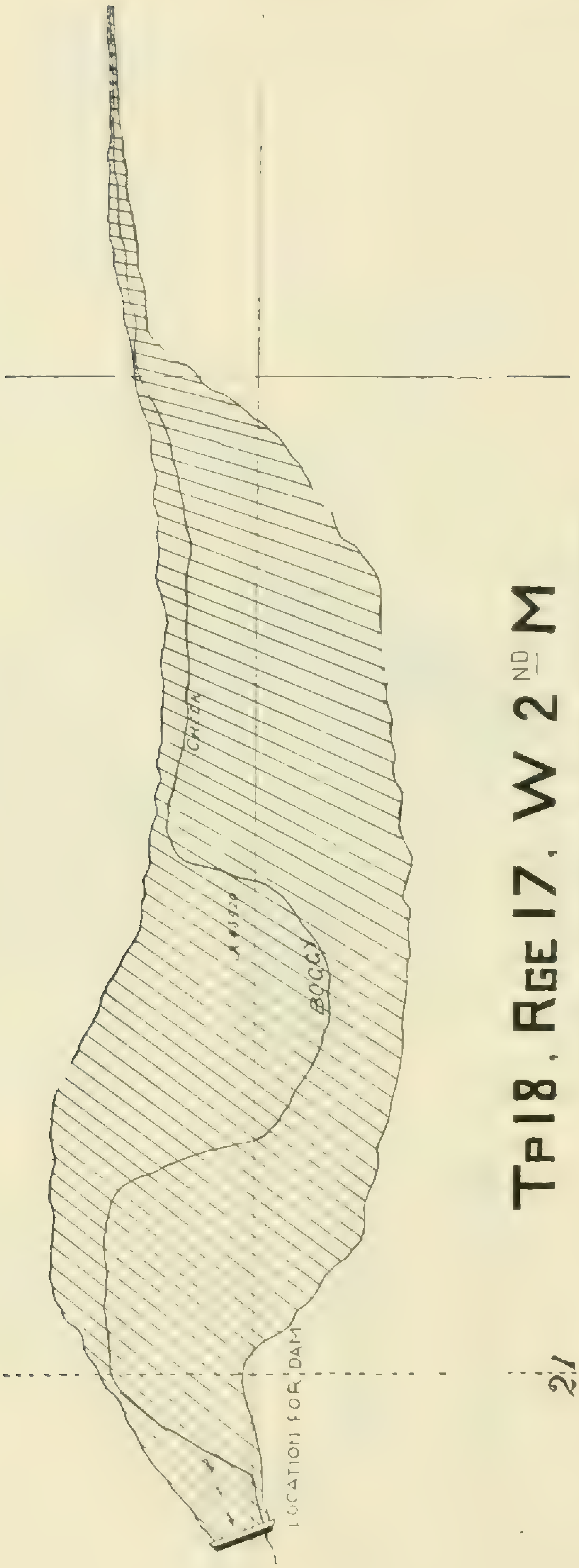


FIG. 6.—RESERVOIR SITE ON BOGGY CREEK.

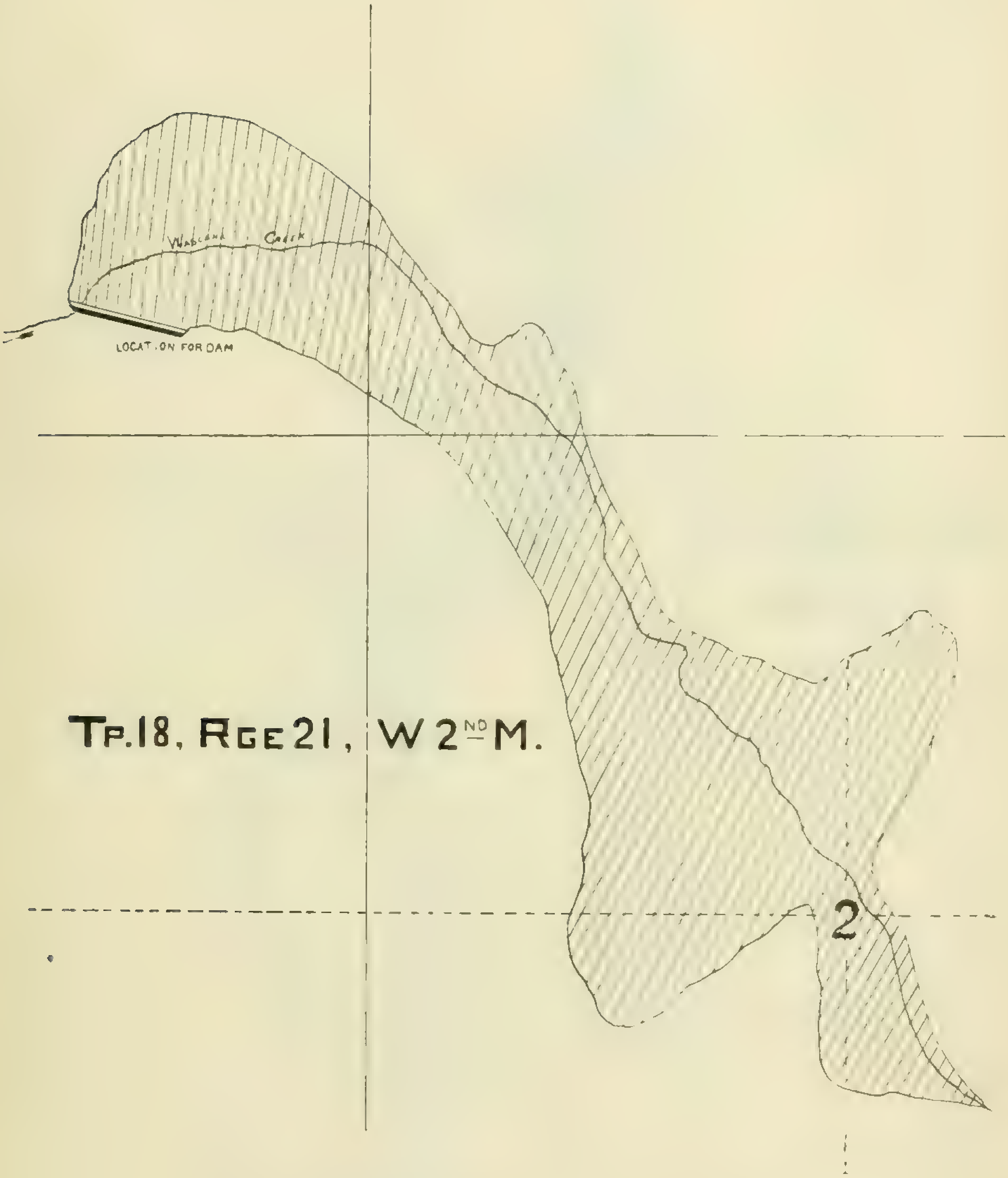


Fig. 7.—RESERVOIR SITE ON WASCANA CREEK.

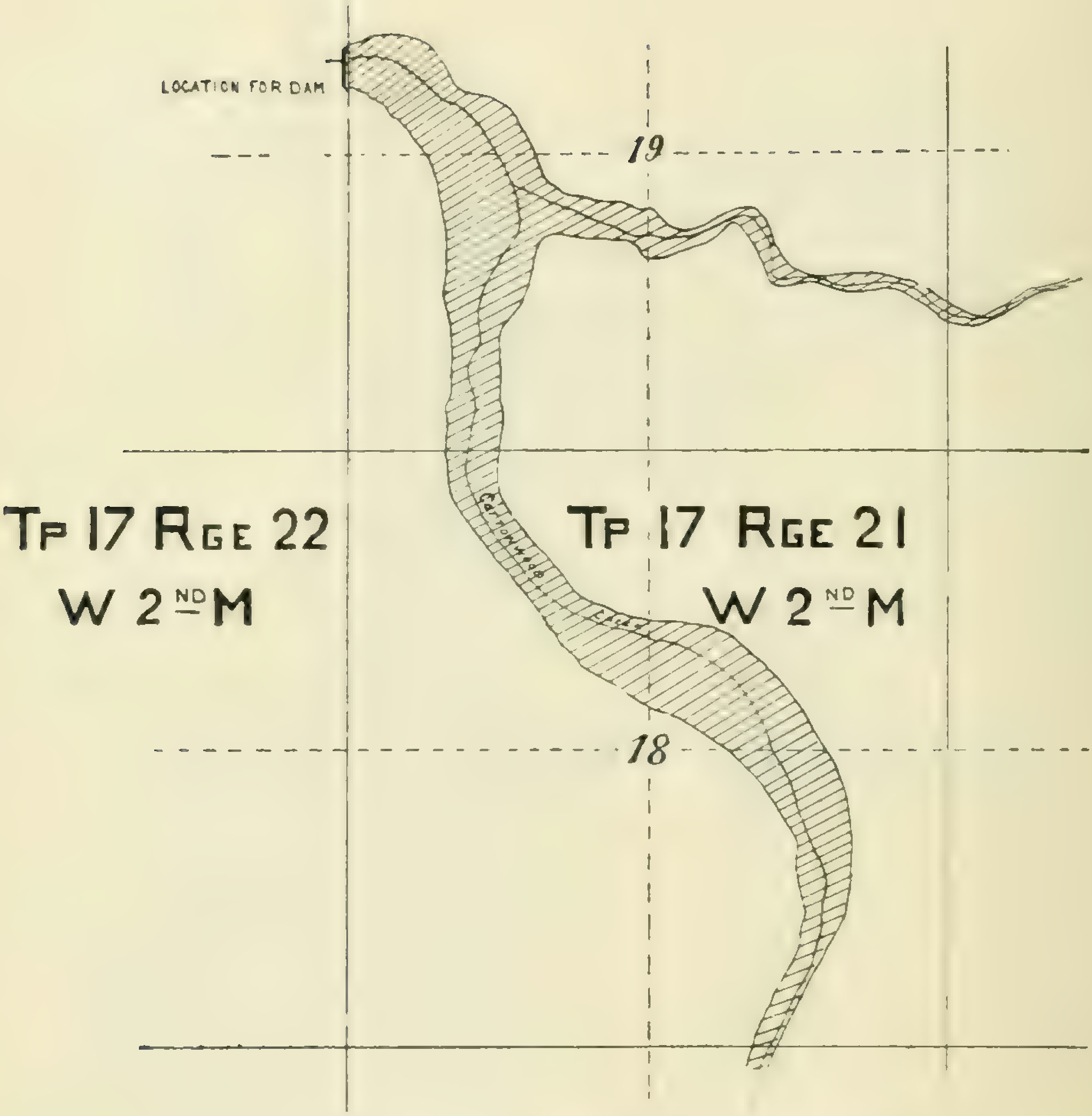


FIG. 8.—RESERVOIR SITE ON COTTONWOOD CREEK.

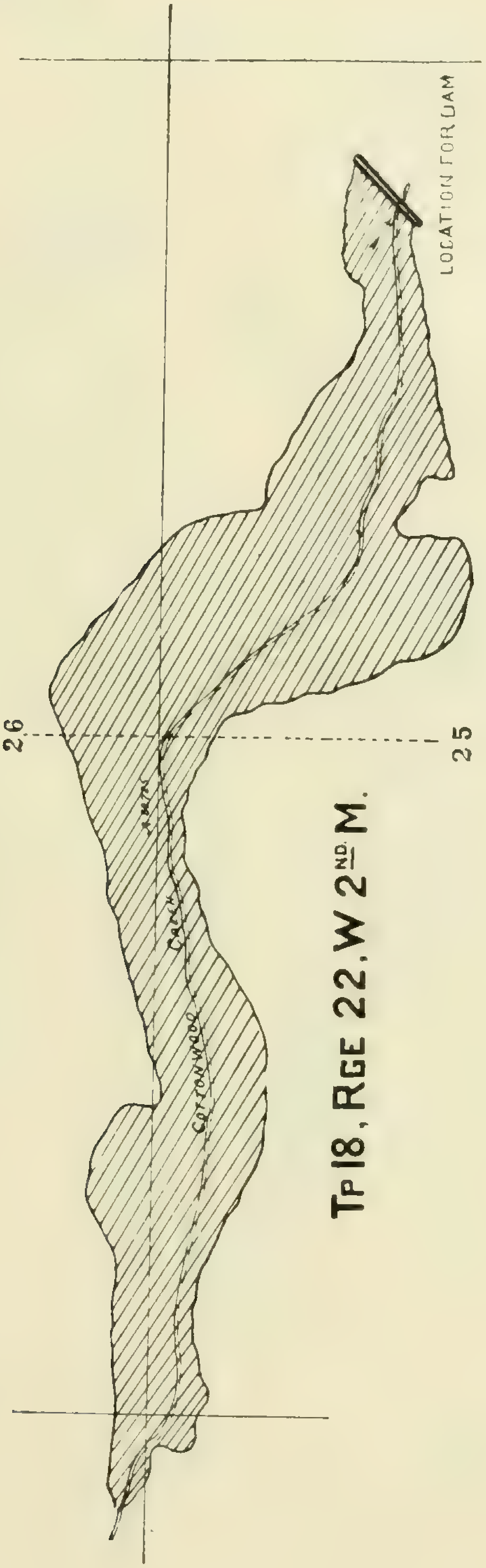


Fig. 9.—Reservoir site on Cottonwood Creek.

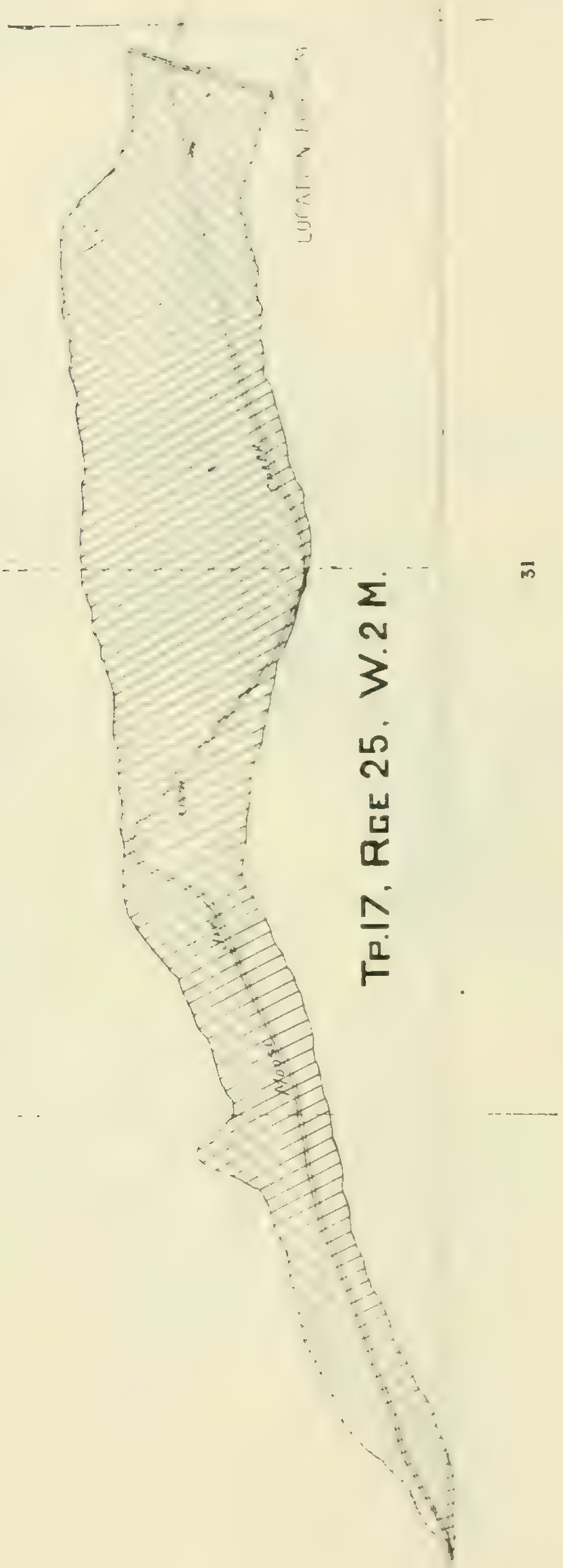


Fig. 10. RESERVOIR SITE ON MOOSEJAW CREEK.

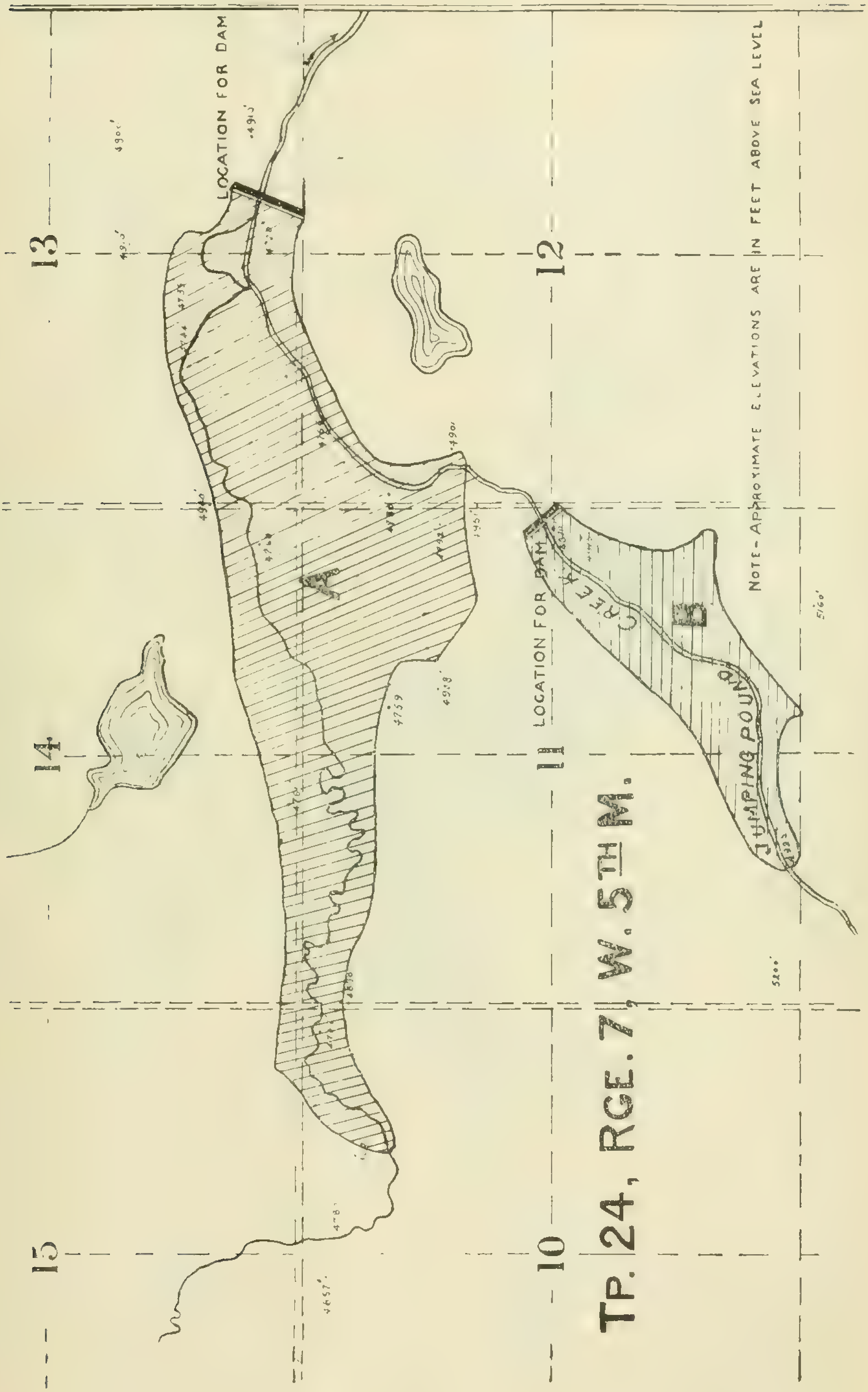


FIG. 11. RESERVOIR SITES "A" & "B".

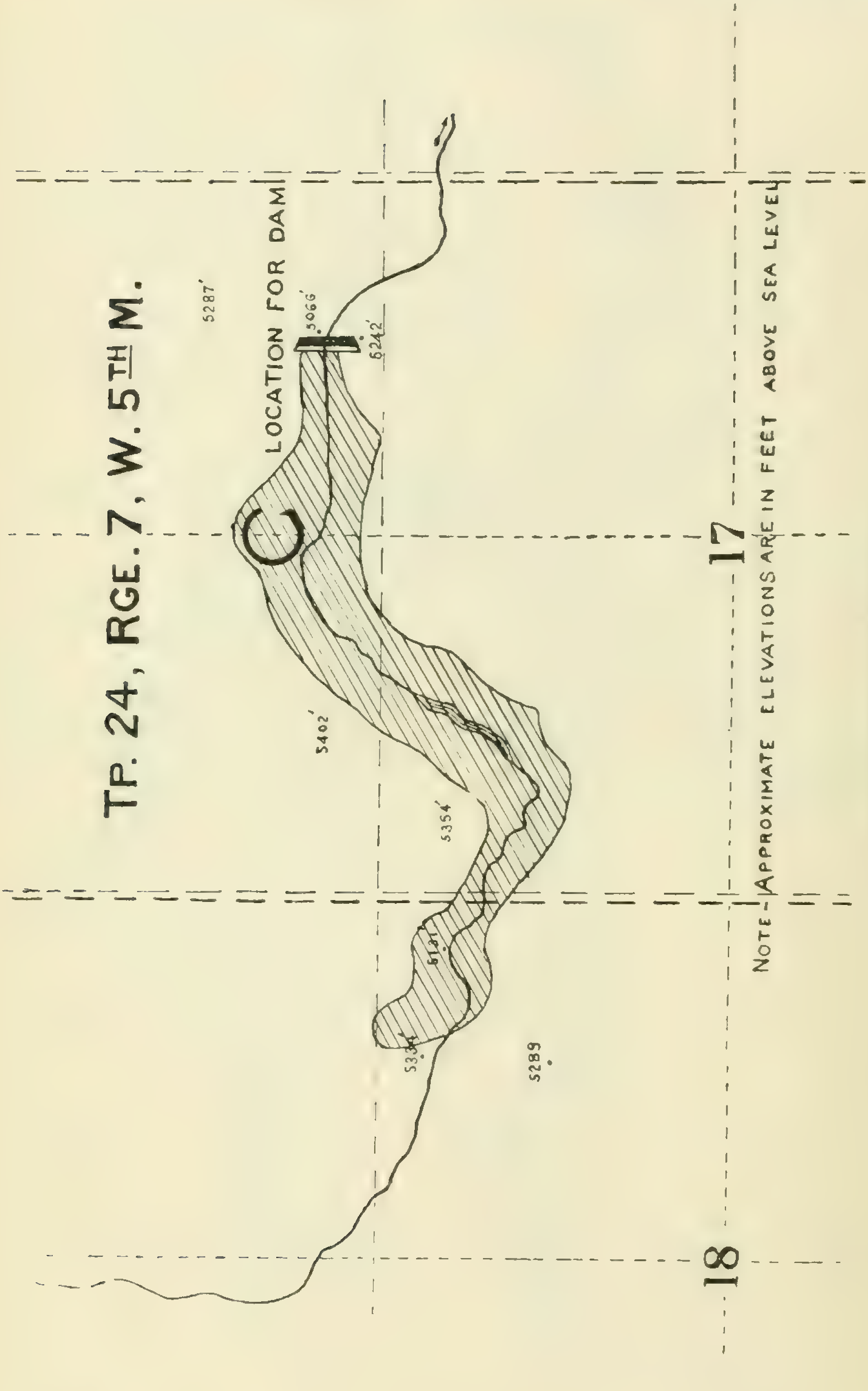


FIG. 12. RESERVOIR SITE "C".

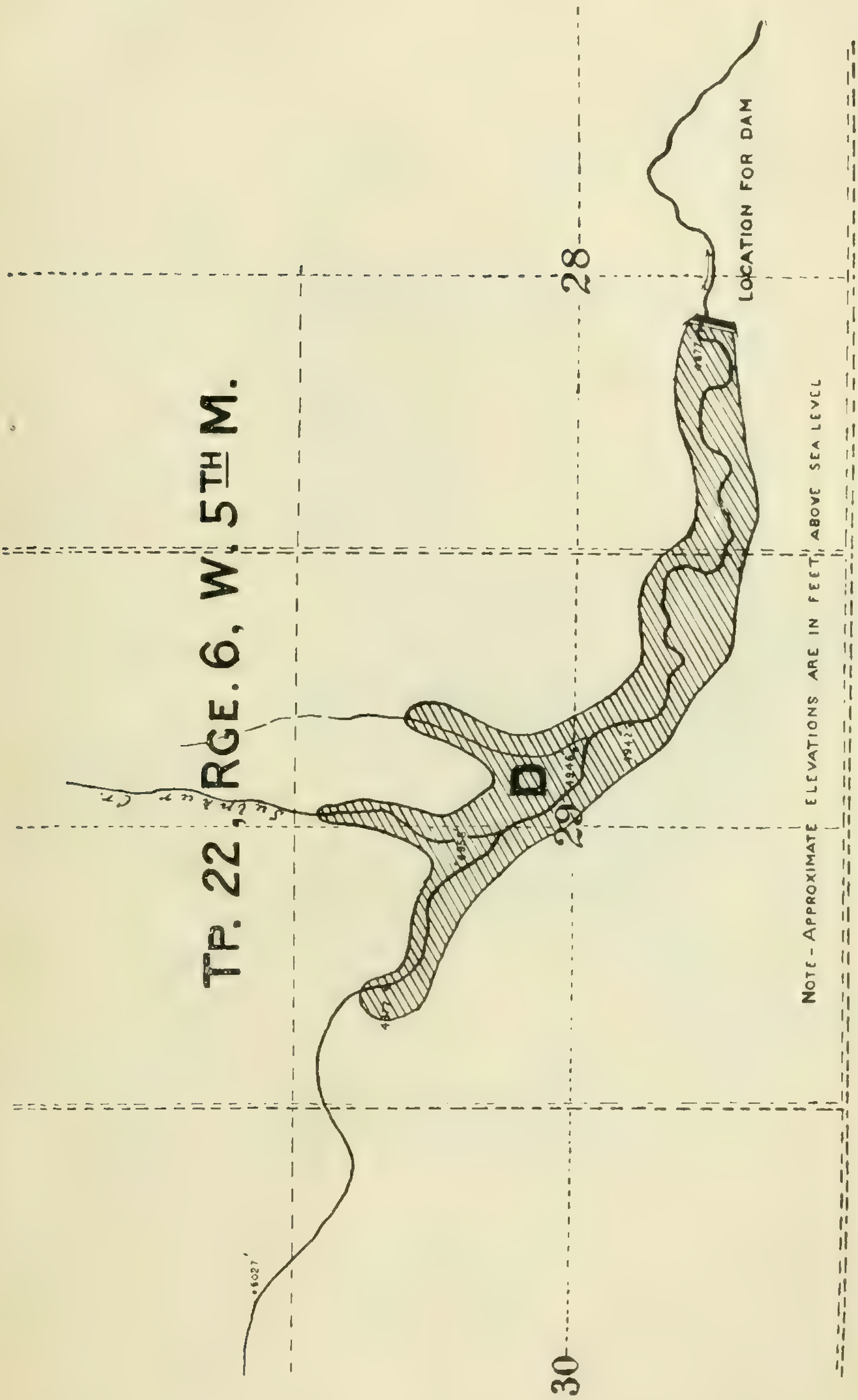


FIG. 13. - RESERVOIR SITE "D".

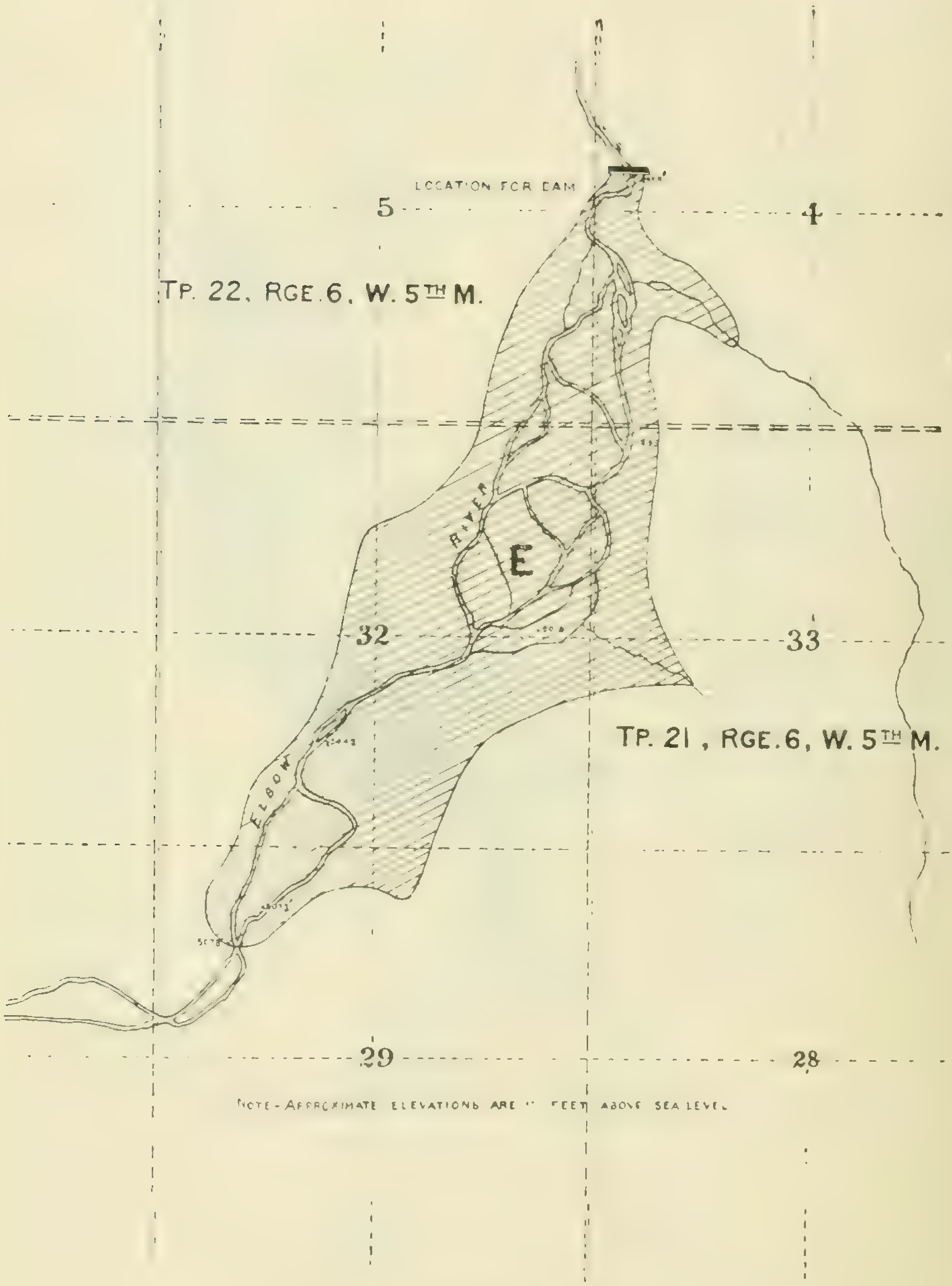


FIG. 14.—RESERVOIR SITE "E".

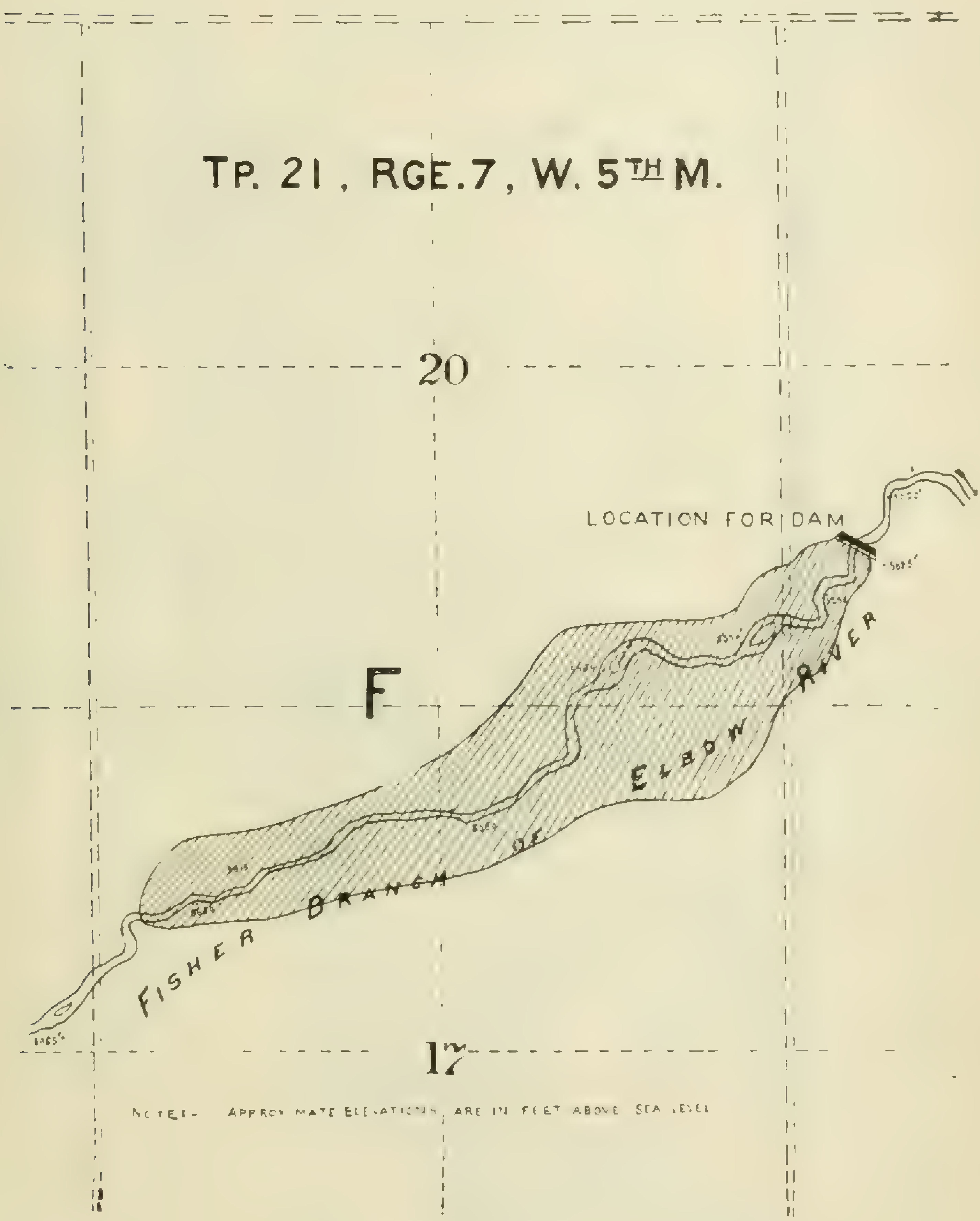


FIG. 15.—RESERVOIR SITE "F".

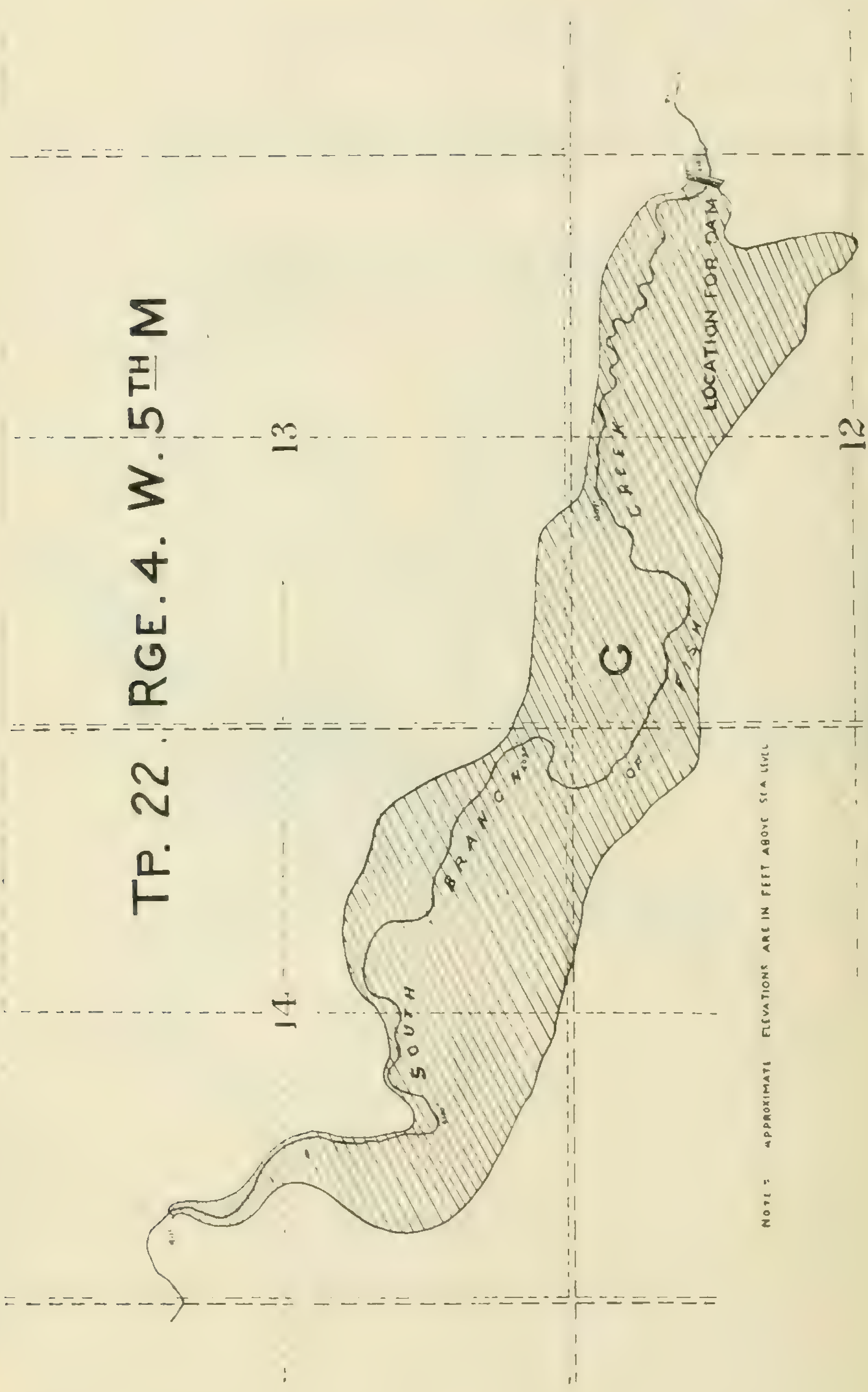


Fig. 16. RESERVOIR SITE "G".

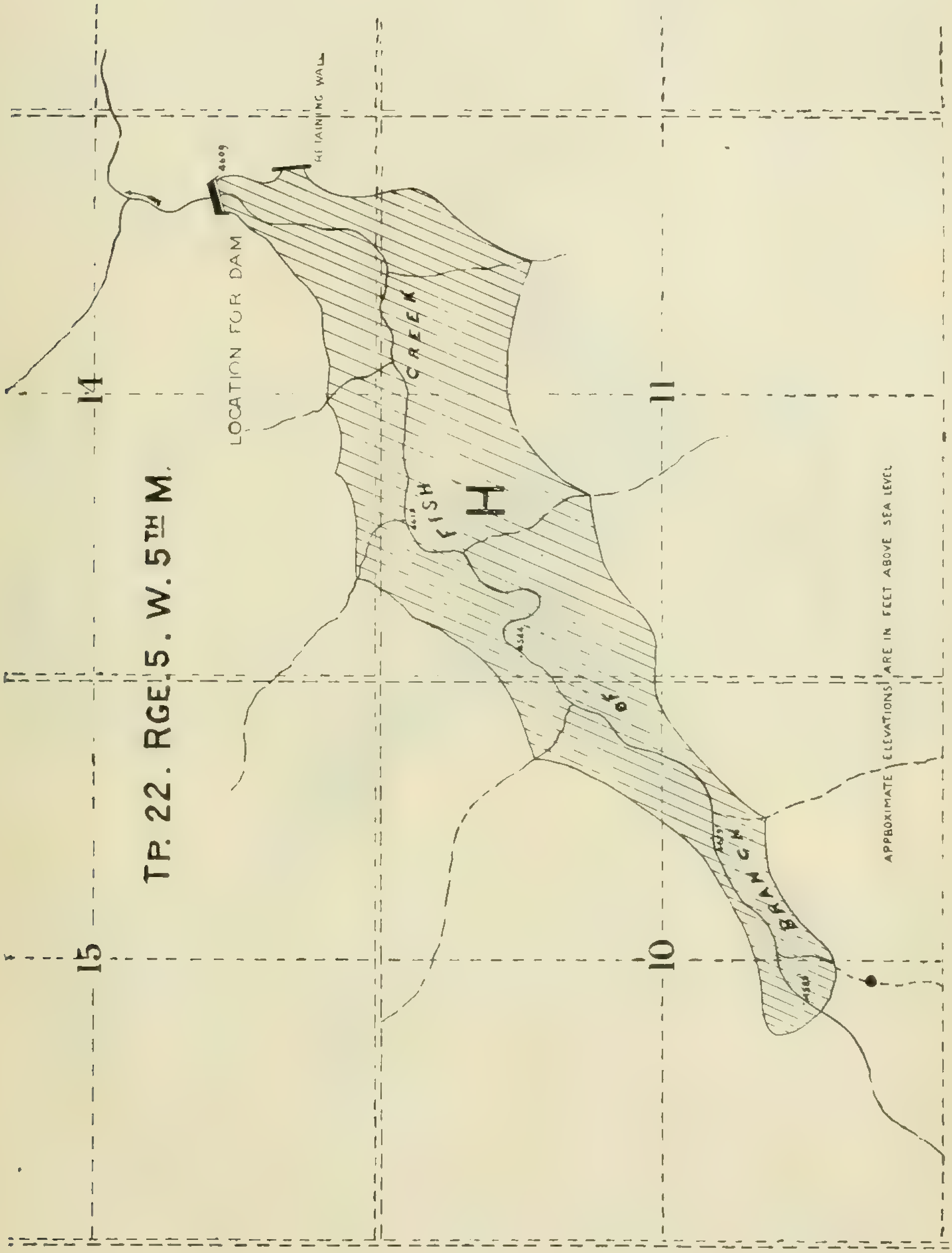


FIG. 17.—RESERVOIR SITE "H".

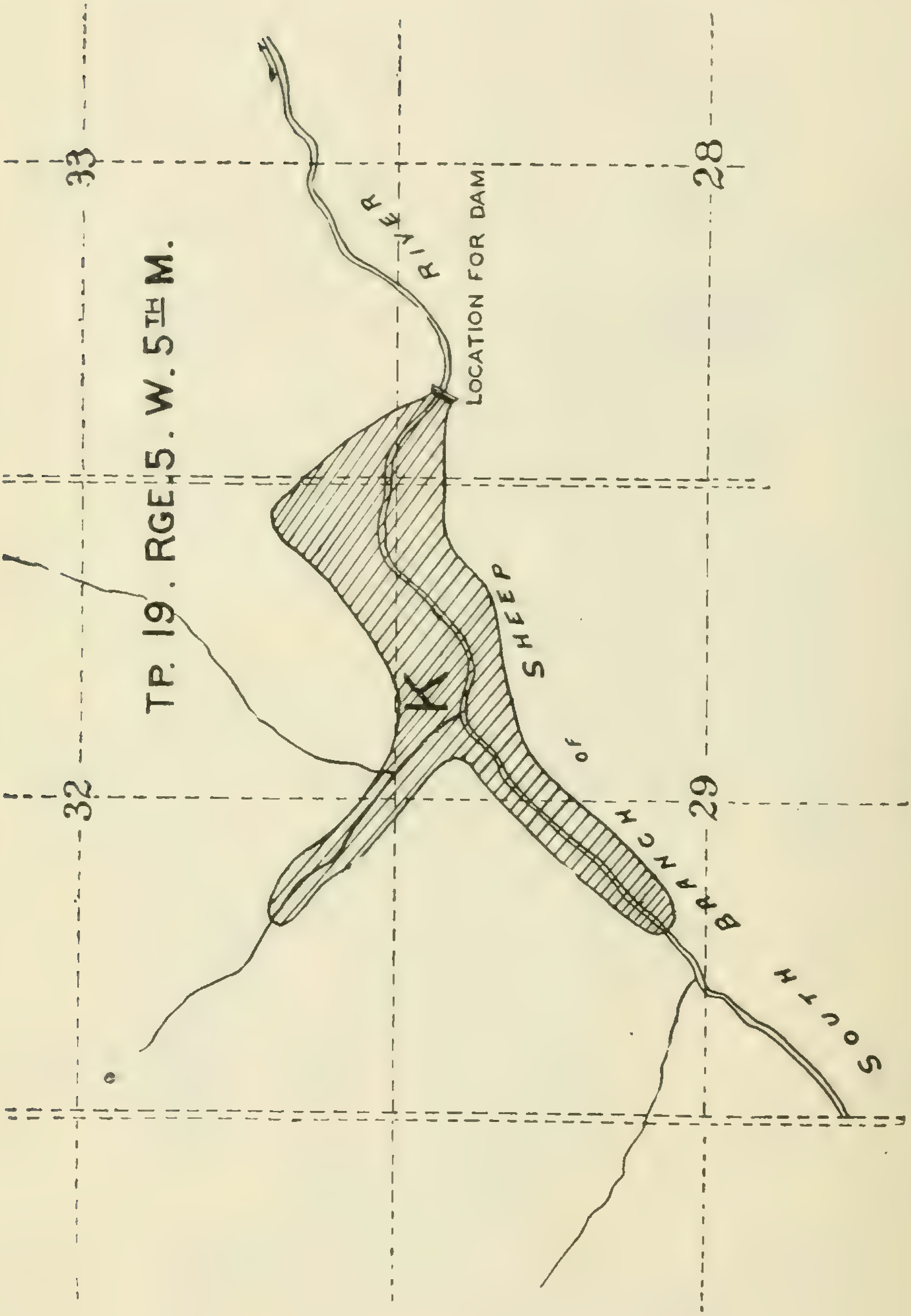


FIG. 18.—RESERVOIR SITE "K."

CANAL SURVEYS.

After the General Irrigation Surveys had been carried on for the first year, it was decided to extend the scope of the work to include the preliminary location of certain proposed canals to divert water from the larger streams to irrigate extensive areas lying contiguous thereto. This decision was due to the fact that a knowledge of the possible diversion of the water of the larger streams was necessary for a proper administration of the law relating to water for irrigation, and because it was recognized that as irrigation and its possible influence on the development of the semi-arid region were little understood by persons who might be inclined to invest money in irrigation undertakings, it was necessary for the feasibility of these larger schemes from an engineering standpoint to be proved by our general irrigation surveys before the detailed work of considering these schemes would be taken up by individuals or companies interested. The canal surveys which have so far been completed, are as follows:—

ST. MARY IRRIGATION CANAL.

The survey of this canal, which has since been constructed by the Canadian North-west Irrigation Company as already mentioned, and which is commonly spoken of as the Galt canal, was made in 1895. This canal survey was undertaken primarily to prove that the large area of first-class land lying south and south-east of Lethbridge could be supplied with water for irrigation from the St. Mary river.

This location proved conclusively that the proposed canal presented no difficult engineering features, and that it was possible to provide water for the large area in question. The proposed location and the special features connected with the undertaking were dealt with in the irrigation reports subsequently published, being illustrated with proper maps and details, and the construction of the canal, on a system modified somewhat from that suggested by the government surveys, but including the main features of that scheme, was undertaken by the Canadian North-west Irrigation Company, and as already explained, their operations have transformed the large area served by the canal from unoccupied wild range land into closely settled and highly cultivated areas.

THE BOW RIVER IRRIGATION CANAL.

Probably the largest area within the arid region which can be supplied with water for irrigation purposes from one source, is that lying along the Canadian Pacific Railway between Calgary and Medicine Hat, east of the Bow river, north of the South Saskatchewan river, and south of the Red Deer river. This district comprises an area of some 6,000 miles, or 3,840,000 acres, of which probably 60 per cent is capable of irrigation.

The soil of a large portion of the district is first class, consisting of heavy sandy and clay loams, with a subsoil of gravel and clay, and the climatic conditions are favourable to the grazing of cattle and sheep, and, with the exceptions mentioned below, to the production of all fodder crops, and in the eastern portions of the district to the production of cereals of all kinds, and also the hardier kinds of fruit. The one feature lacking to make this area highly desirable for settlement is the insufficient rainfall during the majority of years to mature crops, and to provide water for stock.

In 1895 it was decided to investigate the question of the feasibility of diverting water from the Bow river for the reclamation of this large area, and the outcome of that investigation was the preliminary location during that and the following year of the proposed Bow River Irrigation Canal.

The proposed intake for the canal is located on the east side of the Bow river, in Section 13, Township 24, Range 1, West of the Fifth Meridian, a short distance south-east of the city of Calgary, and from thence the location follows closely along the foot of the hill forming the east bank of the valley of the Bow river, utilizing in part the small depression or channel which marks this limit of the hill, and after following this channel for about a mile and a quarter the location deflects slightly to the east so as to cross the Canadian Pacific Railway line a short distance east of the railway bridge at the first crossing of the Bow river.

From that point the location follows the railway line for a short distance and then deflects to the south, following along the east bank of a well defined valley, which marks an old channel of the river, and finally reaches the bench land elevation about Section 16, Township 24, Range 29, West of the Fourth Meridian.

From that point about one hundred miles of main canal and main distributaries are located for the purpose of proving the possibility of distributing the water to the east so as to bring a large area under irrigation.

The general location of the ditches as laid down from our surveys, and of a portion of the lands to be served, will be readily noted from the accompanying map showing the main and distributing ditches of this canal as far as located.

Our surveys in this instance indicated clearly that a canal carrying a large body of water could be constructed without encountering any serious engineering difficulties, and proved the possibility of supplying from the Bow river the necessary amount of water to reclaim upwards of a million and a half acres in the district lying east of Calgary above referred to.

Since the date of preliminary location of this canal the matter of its feasibility and the location of the lands which it is possible to irrigate therefrom, has been carefully looked into by expert engineers employed by the Canadian Pacific Railway Company, who own the area which will be served by the canal, and those investigations have tended to prove the claim advanced that the scheme is a feasible one, and that the expenditure of a moderate amount of money when compared with the large area to be reclaimed, will provide the necessary water for the irrigation of this large block of land, and it is hoped that in the near future the actual construction of the works can be undertaken, with the prospect of duplicating in that district the wonderful results which have been obtained in the way of colonization and development in the district served by the canal constructed by the Canadian North-west Irrigation Company as already explained.

THE RED DEER AND ROSEBUD CANAL.

In that portion of the arid region lying to the north and east of Calgary, there is a large area of country having good soil and a favourable climate, as far as temperature is concerned, but which is almost entirely devoid of water supply.

The district is traversed by the Rosebud river, Knee Hill creek, and Three Hills creek, but these are streams in name only, carrying considerable volumes of water during the period of melting snow, or exceptional rainfall, but ceasing to flow at many points during the summer months, and affording an insufficient supply of water even for domestic purposes. The grass in the district is good, but owing to the scarcity of water its value for grazing purposes is small.

The reclamation of this large area by irrigation, or even the providing of a constant supply of good water for domestic and stock-watering purposes, is deserving of serious consideration particularly at the hands of the different railway companies owning large blocks of land which under present circumstances are useless.

The Rosebud river traverses the central portion of the district from west to east, and in the upper and lower portions of its length is contained in a deep and well-defined valley, with banks precipitous in places, and of considerable height. In the central

portion the channel is very little below the level of the surrounding country, and many favourable sites for easy diversion of water from the channel to the adjacent bench land occur.

The beds of the lakes situated in the upper portion of the Rosebud valley, and different portions of the valley itself, offer very favourable sites for the construction of reservoirs for the storage of water, and the channel of the stream affords a canal already constructed for the distribution of water through the district. It was, therefore, considered a question of first importance to determine the possibility of augmenting the flow of water in the Rosebud by the diversion of water from some of the streams to the west of the height of land in which it takes its rise.

During the season of 1894 a preliminary exploration was made of the country lying between the head of the Rosebud river and the Red Deer river, with a view to determining the possibility of diverting water from the latter stream into the Rosebud and through its channel to the area above referred to.

This exploration indicated that it was possible to divert water from the Red Deer river as proposed, and in 1896 the detailed surveys to finally prove the feasibility of this scheme were completed.

The intake selected for the proposed canal is situated on Section 26, Township 33, Range 5, West of the Fifth Meridian, and the selection was made after a very careful examination of the stream for some miles, both above and below this point. The location in question has the advantage that the river at this point is confined within banks which show some indication of a permanent character, although it is quite possible that during periods of extreme floods the bottom lands in the immediate vicinity of the river may be flooded.

From the point of intake the location proceeds for about one and one-quarter miles almost due east until it reaches the foot of the hills forming the valley of the Red Deer at this point. It then turns in a northerly direction until the slope of the valley in Section 5, Township 34, Range 4, is reached, at which point the height of land between the Red Deer valley and the valley running almost due north from the Little Red Deer river is located, and from this point the location turns sharply to the south, following up the latter mentioned valley to its intersection with the Little Red Deer river. Through the valley of this stream the location is deflected to the east for about four miles, the Little Red Deer river being crossed by a high level flume in Section 1, Township 33, Range 4, West of the Fifth Meridian. From Section 5, Township 33, Range 3, West of the Fifth Meridian the location is deflected to the south, following up the valley of the Dogpound creek for a distance of about ten miles until a sufficient elevation is reached to cross the creek with a low level flume, and from thence the location is deflected sharply to the north, following the easterly valley of this stream until it returns to the height of land between the valley of the Little Red Deer river and a small creek flowing to the south-east into the headwaters of the Rosebud river, the intention being that water diverted from the canal should be carried through this channel into the Rosebud river, and from thence to the south and east for a distance of about one hundred miles, the water being again diverted at favourable points for the reclamation of areas suitable for irrigation in the vicinity of the valley of the Rosebud river. The location above described is a very favourable one for canal construction, with the exception of the crossing of the Little Red Deer river, where a flume about 1,200 feet long and 73 feet in height will be necessary. It is possible, of course, that a more careful examination of the location at this point than was possible in the course of the preliminary location would reveal the fact that a more favourable site for the location of this flume could be found than the one selected, but it is quite evident that a somewhat expensive structure will be required to carry the water across the valley of this stream.

The location contemplated the construction of a canal of the following dimensions:—Bed width, 35 feet; side slopes, $1\frac{1}{2}$ to 1 foot; depth of water, 5 feet; slope or fall of the canal, 2 feet per mile. The above dimensions being calculated to give a dis-

charge of some 520 cubic feet per second, this discharge will probably be sufficient for the irrigation of from sixty to seventy thousand acres, but as the location adopted permits of the construction of some very extensive reservoirs on the headwaters of the Rosebud river, the supply available during the irrigation season can, of course, be largely augmented by the storage of water in these reservoirs. The general location of the canal and the area to be irrigated therefrom will be better understood by reference to the plan herewith showing the location of these lands.

PROPOSED DIVERSION OF WATER FROM THE ELBOW RIVER INTO THE HEAD OF FISH CREEK.

The north fork of Fish creek heads about half a mile from the Elbow river, and from that point there is a well-defined valley running through to the latter stream, in which the height of land is only about fifty feet above the Elbow river.

The fall in the Elbow river was found to be in that locality about 51 feet in a mile, and a ditch $1\frac{3}{4}$ miles in length would serve to deliver any desired quantity of water from the Elbow river into the north fork of Fish creek.

This diversion was desirable, and the surveys therefor were completed, because both the north and south forks of Fish creek and the main stream below the junction of these forks are used as sources of supply for irrigation ditches now in operation, but the flow of water in these streams is so uncertain during dry seasons that it was considered of great importance to determine the possibility of diverting water, as above mentioned, from the Elbow river, so as to augment the flow in Fish creek during dry years.

The surveys completed in connection with this scheme proved that it was entirely feasible, and the location of the proposed canal will be readily noted from the accompanying plan.

PROPOSED DIVERSION OF WATER FROM FRENCHMAN'S CREEK INTO THE HEAD OF SWIFT CURRENT CREEK.

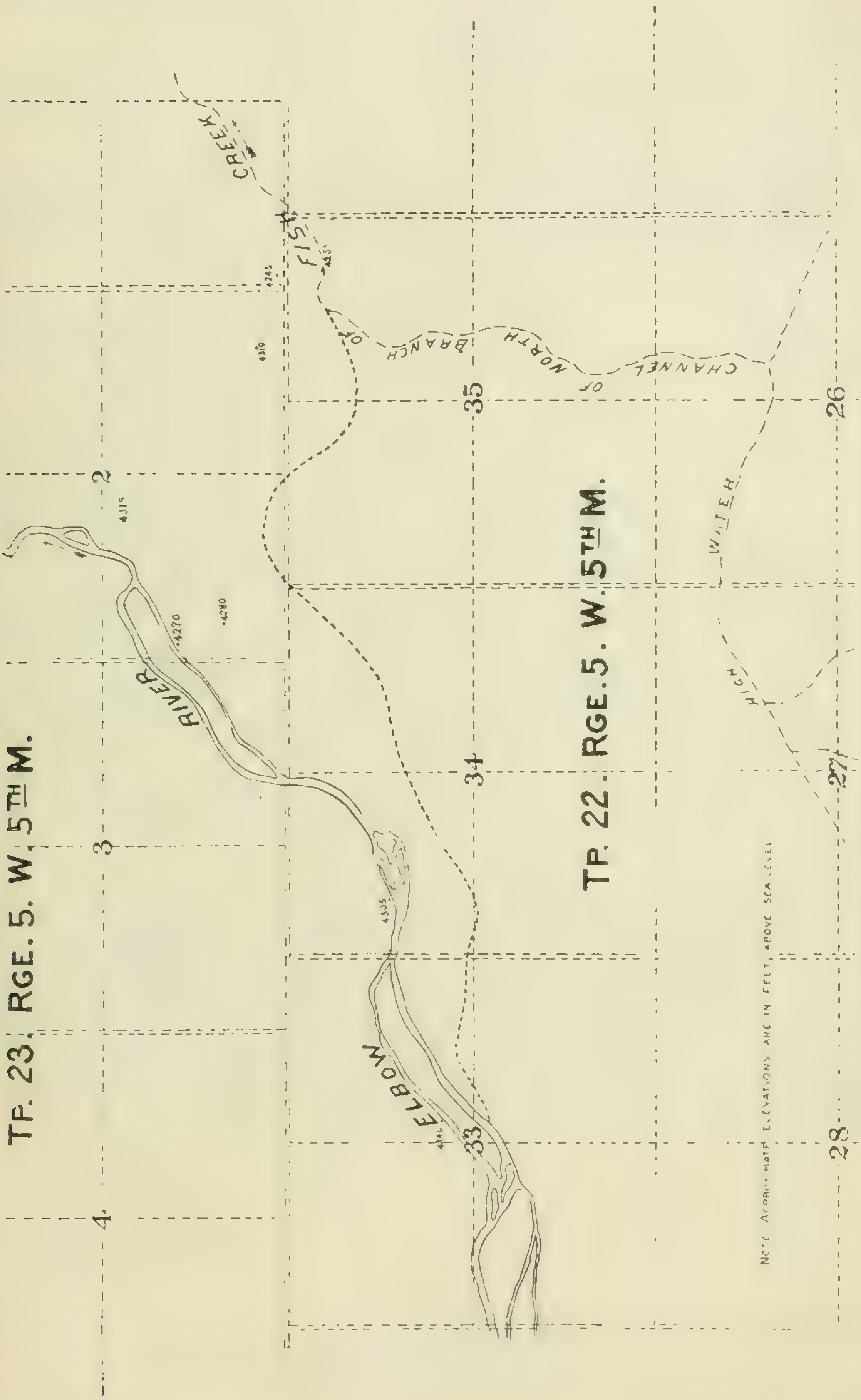
Frenchman's creek forms the main drainage channel for the run-off for the large portion of the southern slope of the Cypress Hills, and in 1896 a survey was made to prove whether this run-off, which now finds its way to the south in the channel referred to, through a district not well suited for irrigation development, could be diverted into Swift Current creek and through that source conveyed to areas on the northern and north-eastern slopes of the Cypress Hills, which, owing to the proximity of the Canadian Pacific Railway, and the character of the soil in the district, promises favourable returns from irrigation.

The surveys which were completed during that year, and some further detailed work done on the scheme in the following year, indicated that the proposed diversion was possible, but that as it would involve a very considerable expenditure it was not likely to come within final limits until land values in that district had materially increased.

The location of the proposed canal and the outlines of the scheme will be understood from the accompanying map.

THE MILK RIVER CANAL.

To the east of the Milk River Ridge and the area served by the Canadian Northwest Irrigation Company's canal there is a district containing good soil, but which is very lacking in sufficient surface water for stock watering, and which is particularly



PROPOSED DIVERSION—ELBOW RIVER TO FISH CREEK.

lacking in sufficient rainfall to permit of successful farming. This district can only be supplied with water for irrigation purposes or stock watering from the Milk river, situated to the south of the tract, or by the extension of the present canal system of the Canadian North-west Irrigation Company's canal, taking water from the St. Mary's river. To determine the possibility of obtaining water for this area from Milk river, exploratory surveys were undertaken as part of the general surveys in 1901, and the feasibility of the project having been proved, the preliminary location of a canal to divert the necessary water was completed.

The intake for the proposed canal was located on the south-east quarter of Section 29, Township 2, Range 17, West of the Fourth Meridian, on the north or left bank of the Milk river, where a well-defined coulee about eight feet deep runs into the river through a flat of from 500 to 800 feet in width.

The proposed point of intake would seem to be a favourable one, as by enlarging the coulee from the river up to the point where the head-gates are proposed to be located, a secure position for the latter can be obtained. It will be necessary at this point to construct a weir across the river and low lands on the right bank below the mouth of the coulee to raise the water sufficiently to give a proper slope at the intake at all stages of the stream.

The proposed location of the canal follows the left bank of the river from the point of intake for a distance of 9,200 feet, and then crosses the stream and valley by a flume 1,020 feet in length to avoid high cut banks on Sections 26 and 27. The location again crosses the river on Section 25, Township 2, Range 16, by a flume 1,300 feet in length. From the latter point the location is carried along the southerly slope of a lower continuation of Milk River Ridge to the west side of the Alberta Railway and Coal Company's line, in a depression locally known as Railway Coulee. This brings the location to the north-easterly slope of the Milk River Ridge. From there the location is continued north and north-westerly to Section 12, Township 3, Range 17, West of the Fourth Meridian, and the work done from the intake to the latter point clearly proved that no serious engineering difficulties were found to exist in constructing a canal on this location to divert all the available water from Milk river for the irrigation of the tract above mentioned.

The canal as located is designed to carry 500 cubic feet of water per second, being given a bottom width of 35 feet, with side slopes of 1½ to 1, and a depth of 5 feet of water flowing with a velocity of 2·39 feet per second, the total length of canal as located being approximately 30 miles.

The general location of the canal, and the area which it is proposed to serve therefrom will be readily understood from the accompanying map, which shows the canal and also the situation of the lands proposed to be irrigated. The general exploratory surveys completed in connection with this location indicate that very favourable storage facilities are obtainable in the district, the utilization of which will enable the total high water or flood flow of the Milk river to be stored at these sites until required during the irrigation season. It is also clear, as will be noted from the general map, that it will be possible to maintain a flow of water in the large natural drainage channels which intersect the tract during all seasons of the year, and thus render the territory adjacent thereto of value for stock-raising purposes.

ELEVATIONS of Various Points Throughout the North-west Territories and Manitoba.

TOWNS AND CITIES.

	Elevation in feet above Sea Level.
Battleford, Saskatchewan	1,609
Brandon, Manitoba	1,194
Calgary, Alberta	3,428
Gleichen, Alberta	2,952
High River, Alberta	3,394
Lethbridge, Alberta	2,982
Macleod, Alberta	3,128
Maple Creek, Assiniboia	2,495
Medicine Hat, Assiniboia	2,171
Moosejaw, Assiniboia	1,767
Portage la Prairie, Manitoba	854
Prince Albert, Saskatchewan	1,398
Red Deer, Alberta	2,806
Regina, Assiniboia	1,885
Strathcona, Alberta	2,188
Swift Current, Assiniboia	2,423
Wetaskiwin, Alberta	2,480
Winnipeg, Manitoba	757

RIVERS.

Assiniboine River—	
At confluence with Red river	725
At crossing of Principal Meridian	757
At confluence with Souris river	1,110
At confluence with Qu'Appelle river	1,262
Battle River—	
At confluence with Saskatchewan river	1,500
At Canadian Pacific Railway (Edmonton branch) bridge	2,612
At Battle Lake	2,795
Belly River—	
At confluence with Bow river to form the South Saskatchewan river	2,212
Near confluence with St. Mary river	2,729
Near confluence with Oldman river	2,852
Near confluence with Waterton river	3,147
At International Boundary	4,728
Bow River—	
At confluence with Belly river to form the South Saskatchewan river	2,212
Near confluence with Highwood river	3,096
At Langevin bridge, Calgary	3,400
Lower Bow lake	5,530
Upper Bow lake	6,200
Elbow River—	
At confluence with Bow river	3,393
At Canadian Pacific Railway bridge at Calgary	3,394
At mouth of canyon branch of Elbow river	4,725

ELEVATIONS of Various Points Throughout the North-west Territories and Manitoba.

	Elevation in feet above Sea Level.
Highwood River—	
Near confluence with Bow river	3,096
Near confluence with Sheep river	3,222
At exit from Mountains	4,780
Milk River—	
At International Boundary	2,600
At Alberta Railway and Coal Company's railway bridge	3,401
At confluence of north and south branches	3,512
At International Boundary	4,145
Oldman River—	
Near confluence with Belly river	2,852
At Macleod	3,376
At exit from Mountains	4,437
Qu'Appelle River—	
At confluence with Assiniboine river	1,262
At Canadian Pacific Railway (Prince Albert Branch) bridge	1,606
At height of land between Aiktow creek and Qu'Appelle river	1,798
Red River—	
Lake Winnipeg	710
At Lower Fort Garry	712
At mouth of Assiniboine river	725
Red Deer River—	
At confluence with South Saskatchewan river	1,892
At Canadian Pacific Railway (Edmonton Branch) bridge	2,773
At source	6,660
Saskatchewan River—	
Lake Winnipeg	710
Cedar lake	828
At confluence with South Saskatchewan river	1,250
At Prince Albert	1,360
At mouth of Battle river	1,500
At Edmonton	1,995
Sheep River—	
Near confluence with Highwood river	3,222
At Highway bridge, Okotoks	3,438
South Saskatchewan River—	
At confluence with Saskatchewan river	1,250
At Saskatoon	1,538
At confluence with Red Deer river	1,892
At Medicine Hat	2,137
At confluence with Bow and Belly rivers	2,212
Souris River—	
At confluence with Assiniboine river	1,110
At 1st crossing of International Boundary	1,415
At 2nd crossing of International Boundary	1,650
At Canadian Pacific Railway (Pasqua Branch) bridge at Roche Percée	1,707

ELEVATIONS of Various Points Throughout the North-west Territories and Manitoba.

	Elevation in feet above Sea Level.
St. Mary River—	
At confluence with Belly river	2,729
At Canadian Pacific Railway (Crow's Nest Branch) bridge	2,739
At confluence with Lee creek	3,625
At International Boundary	4,127
Waterton River—	
Near confluence with Belly river	3,147
Waterton lake	4,186
Along the line of Canadian Pacific Railway (Main Line)—	
Winnipeg	757
Portage la Prairie	854
Virden	1,444
Indian Head	1,738
Qu'Appelle	1,747
Broadview	1,960
Regina	1,885
Moosejaw	1,767
Parkbeg	1,982
Chaplin	2,202
Summit of railway on Missouri Couteau	2,282
Swift Current	2,423
Gull lake	2,562
Crane lake	2,518
Maple creek	2,495
Walsh	2,430
Irvine	2,493
Dunmore Junction	2,308
Medicine Hat	2,171
Langevin	2,495
Tilley	2,462
Gleichen	2,952
Calgary	3,428
Cochrane	3,749
Morley	4,067
Canmore	4,284
Banff	4,521
Summit of Kicking Horse Pass	5,329
Along the line of the Canadian Pacific Railway—Crow's Nest Branch—	
Dunmore Junction	2,308
Montana Junction	3,009
Lethbridge	2,982
Macleod	3,128
Pincher	3,818
Blairmore	4,226
Summit of pass through Rocky Mountains	4,449
Prince Albert Branch—	
Regina	1,885
Craven	1,630
Saskatoon	1,574
Duck lake	1,645
Prince Albert	1,398

ELEVATIONS of Various Points Throughout the North-west Territories and Manitoba.

	Elevation in feet above Sea Level.
Craven Spur—	
Craven	1,630
End of track	1,606
Pasqua Branch—	
Pasqua Junction	1,872
North Portal	1,944
Edmonton Branch—	
Calgary Junction	3,410
Crossfield	3,622
Red Deer	2,806
Lacombe	2,783
Wetaskiwin	2,480
Strathcona	2,188
Macleod Branch—	
Calgary Junction	3,410
Okotoks	3,439
High river	3,394
West Macleod	3,108
Macleod	3,128
Along line of Alberta Railway and Coal Company's Railway—	
Lethbridge	2,982
Montana Junction	3,009
Stirling	3,045
Brunton	3,308
Summit of Milk river on line of railway	3,474
Milk river	3,420
Coutts—International Boundary	3,463
Along line of St. Mary's River Railway—	
Stirling Junction	3,043
Magrath	3,210
Spring Coulee	3,578

LAW RELATING TO USE OF WATER

SYNOPSIS OF LAW

RELATING TO THE USE OF WATER FOR IRRIGATION.

Although the principle of the artificial use of water for irrigation on this continent is much older than the laws relating to land titles, the want of permanency of title to the water used in this way has been one of the greatest drawbacks to modern irrigation development.

There has not been, in the earlier stages of western development, much difficulty in convincing legislative bodies of the necessity for the enactment of such laws as would confer undisputed title upon the owner of a farm, but the wisdom of giving that owner an equally good title to the water for irrigation, without which his farm, if situated in the arid or semi-arid portion of the continent, is useless, has not been so readily recognized.

In Canada the necessity for legislation regarding the important subject of the use of water for irrigation has become apparent only during the past few years, and may in fact be said to date from the time, within the past decade, when the earlier settlers in the southern and south-western portions of the North-west Territories had by painful experience proved that farming without the aid of irrigation was a precarious undertaking.

Fortunately, however, the necessary legislation followed almost immediately upon the footsteps of crop failures, and there was practically a clear field, as far as vested rights were concerned, for the introduction of laws upon the subject of water rights. This fact has had much to do with the success and the absence of litigation so far attending the administration of the Canadian irrigation law.

The Canadian law relating to the use of water for irrigation is contained in two enactments, viz.:—'The North-west Irrigation Act,' and 'the Irrigation District Ordinance.'

The first mentioned or parent law is an Act first passed by the Dominion Parliament in 1894, and subsequently amended and consolidated, while the Irrigation District Ordinance is an enactment of the Territorial legislature authorizing the formation of 'irrigation districts,' which after acquiring a water right under the Irrigation Act are empowered to construct the works for the utilization of such water as a municipal undertaking.

For convenience and continuity of narrative these laws are discussed separately in the order given.

Prior to the passage of the North-west Irrigation Act there was in Canada no law, except a provincial enactment in British Columbia, which dealt with the diversion of water from its natural channels for use in irrigation, and in framing such a law it was realized that many principles differing materially from common and existing statutory law must be adopted. The method followed in framing the law has had much to do with its successful administration. The Act was first drafted to embody such of the principles contained in the irrigation laws of different irrigable states and territories of the United States, and legislation upon this subject in other colonies of the British Empire as seemed applicable to local conditions in Canada, and was then submitted during a two months' trip of the writer through all the irrigation states to recognized authorities upon local irrigation laws for criticism. The information thus obtained disclosed weak points and unforeseen conditions in the original draft, and enabled many valuable amendments to be made before the Act was finally submitted to Parliament for consideration. Two years' administration of the Act indicated further de-

sirable amendments to simplify and extend some of its provisions, and the Act was therefore consolidated and amended in 1898.

The Canadian North-west Irrigation Act is based upon certain definite principles, which may be briefly stated as follows:—

(1.) That the water in all streams, lakes, ponds, springs or other sources is the property of the Crown.

(2.) That this water may be obtained by companies or individuals for certain described uses upon compliance with the provisions of the law.

(3.) That the uses for which water may be so acquired are 'domestic,' 'irrigation' and 'other' purposes, domestic purposes being limited to household and sanitary purposes, the watering of stock, and operation of railways and factories by steam, but not the sale or barter of water for such purposes.

(4.) That the company or individual acquiring water for irrigation or other purposes shall be given a clear and indisputable title to such water.

(5.) That holders of water rights shall have the protection and assistance of permanent government officials in the exercise of such rights.

(6.) That disputes or complaints regarding the diversion or use of water shall be referred to and settled by the officials of the government department charged with the administration of the Act, and that decisions so given shall be final and without appeal.

Probably the most satisfactory way to make it clear how the above principles are worked out in practice will be to deal in detail with a specific case, and then to explain the general provisions of the Act as they bear upon this case.

We will, therefore, consider the case of a company formed to construct an irrigation ditch or canal for the reclamation of any area, and trace the undertaking from its inception to completion, so as to illustrate in a practical way the provisions of the law as affecting such undertakings, and it may incidentally be noted that such explanation will cover practically all cases dealt with under the Act, the proceedings differing only in minor details for large or small undertakings.

The company having been formed, either under a special Act of incorporation or by letters patent under the joint stock companies' laws, for the purpose of constructing irrigation works and engaging in the sale of land with water attached thereto for irrigation, or possibly simply to supply water to the present owners of the lands to be irrigated, proceeds to make the necessary surveys to determine the feasibility and approximate cost of their undertaking, and provide the necessary information as to location and character of the works to be constructed and land to be irrigated.

In this connection it may be pointed out that the general irrigation surveys performed by the government, and the maps issued to illustrate these surveys, serve in a general sense to show whether any specified area of land can be irrigated from a given source, and the company is only called upon to make the actual ditch or canal location required to permit of details of cost, &c., to be figured upon.

In making their surveys the engineers employed by the company have necessarily to trespass upon lands which do not belong to the company, and to give them a legal right to do this the company file with the Chief Engineer of the Department of Public Works for the Territories a general description of their proposed undertaking, and upon payment of a fee of $3 obtain a license authorizing their engineer to enter upon all public or private lands for the purpose of making necessary surveys connected with the proposed undertaking.

Having completed their surveys and finally elaborated their scheme, the company proceeds to the next step by filing with the Commissioner of Public Works for the Territories a memorial together with certain illustrating plans and profiles, containing full information as to the organization and financial standing of the company, the location, character and cost of their proposed undertaking, the location and character of the land to be irrigated, and the terms and price to be charged for water supplied for the irrigation of such land. The application is duly examined and recorded in the Chief Engineer's office against the stream or other source from which the water is to

be diverted, provided there is water available for appropriation, but if the records show that the supply available from the proposed source is already granted, or if the examination proves the scheme does not comply with the provisions of the law, the application is refused and applicants notified accordingly; if approved, one copy of the memorial and plans is filed with the Department of the Interior at Ottawa, and the applicants instructed to publish the notice of their application. The company then gives public notice of its having filed the memorial and plans by publication of a notice in five weekly issues of a local newspaper named by the commissioner, and files a copy of each issue of the paper containing the notice in the Chief Engineer's office.

If at the expiration of the publication of the notice referred to no protest against granting the application is received, the Chief Engineer issues a certificate that the provisions of the law relating to the publication of the notice of application have been complied with, and at the same time makes a recommendation regarding the issue of an authorization for construction of the proposed works to the company, and the length of time to be given it to complete the undertaking.

The authorization issued to the company empowers it to proceed with the construction of the proposed works, and if necessary to expropriate private or public lands required therefor, the time within which such works are to be completed being set forth therein.

Should any protest against granting the application be filed during the period of publication of the notice, the protest is considered and ruled upon, and any damages or amendments ordered are endorsed on the memorial and plans.

Having obtained their authorization, the company proceeds with the construction of the works, subject to inspection of the Chief Engineer during progress, and to special inspection at any time should complaint be made that the work is not being carried out in accordance with the law, and the plan and memorial filed.

Upon completion of the construction of the works connected with the undertaking, or the expiration of the time limit and any extension thereof which may have been granted, a final inspection is made by the Chief Engineer, who issues a certificate containing a recommendation for the granting of a final license covering the water granted, and this license, upon payment of a fee of $10, is issued and duly registered or recorded in the Irrigation Office at the Department of Public Works against the source from which water is granted. The number which the license bears shows its priority of right against the source, and the certified copy given the company is prima facie evidence of its title to the water therein granted in exactly the same manner as a patent or registered deed would be evidence of the ownership of the land or other property conveyed thereby.

The foregoing will serve to indicate in a general way the method of acquiring water rights under The North-west Irrigation Act, 1898. It is now proposed to discuss in a somewhat fuller and more comprehensive manner the provisions of this law in their bearing upon these rights and their use after acquirement.

It may be pointed out in the first place that the law recognizes as a foundation principle that only by an absolute repeal of the common law of riparian right can the use of water for irrigation be successfully introduced, and having enunciated the principle that all water is the property of the Crown, provision is then made for transfer of the title to this water from the Crown to the company or individual desiring to put it to certain uses defined by the law through a well-considered and carefully administered system of registration.

To make the record of rights complete and to prevent disputes regarding vested rights at the time of the introduction of the law, provision was made therein that all rights of a kind similar to those which can be acquired under the Act were required to be registered before a specified date, and the wisdom of this provision will be recognized when it is remembered that only by having a complete record of the rights to water can it be hoped to deal intelligently with the supply from such source.

The provisions of the law relating to the form of application to be filed, and the information to be given by the maps and plans accompanying the application are worthy of brief reference.

It will be noticed that the memorial, maps and plans are required to contain full information not only as to the location and character of the works to be constructed, the lands to be irrigated by the water applied for, the character and value of the land to be reclaimed, the price to be charged for water supplied, &c., but also with reference to the financial standing of the applicants.

This full information enables the application to be criticized not only from an engineering standpoint, but also as a business venture, before being approved, and does much to prevent the introduction of 'wildcat' or 'boom' enterprises.

It was recognized in the earliest stages of the administration of the law that the first duty of the government was to endeavour by a careful system of topographical and hydrographical investigations to determine the actual supply of water available from each source, and to accomplish this the Canadian irrigation surveys were inaugurated and carried on systematically each year. One of the main features of the work undertaken is to endeavour to determine by careful measurements and gaugings the actual supply of water available from each stream or other source for irrigation, so as to know what there is to grant, and by limiting the records against any source to the available supply prevent the possibility of waste of money resulting from the construction of canals and ditches for which the owners can not hope to obtain water without taking what rightly belongs to some one else.

This phase of the administration of the law is dealt with somewhat as follows:—

Each stream, or in fact any source from which water may be diverted, is given a place in a register containing as it were a debit and credit account for water, the credit side being filled up from measurements and gaugings of the supply at low water, high water and flood discharge, and the debit side being a charge against this supply of rights to such water acquired under the Act. A glance at this register at any time shows the exact balance between available supply and recorded rights, and permits of immediate settlement of the question of whether there is water available to meet the requirements of each application as it is filed for approval.

This system practically delegates to the officials administering the Act the power to prevent the probability of future disputes between the holders of water rights by refusing to approve any application which it is considered might tax any source of supply beyond its capabilities and thus cause friction between recorded rights, and although this method of dealing with the subject may seem drastic it is held to be reasonable that the Crown should not undertake to dispose of more water than it can deliver, and it will, I think, be admitted that the introduction of this system in the earlier days of irrigation development will tend to prevent waste of money in endeavouring to enforce or protect fictitious water rights by long drawn out legal contests.

The provisions of the law regarding public notice of the filing of applications for water rights, and for the consideration and summary disposal by the minister of protests filed, have resulted in clearing many undertakings in their inception of objections and disputes which if left for settlement until later on would certainly have resulted in much annoyance, and in some cases serious inconvenience in the way of lawsuits.

A fruitful cause of trouble with all undertakings necessitating the taking of land for the purposes of right of way is the question of the area to be taken and the price to be paid therefor.

Under the Canadian irrigation law the possession of an authorization puts the holder in a position to expropriate the land necessary for the right of way, and makes the ruling of the minister final as to the area necessary, the question only of the price being settled by arbitration. These provisions also are designed to prevent the ever present lawsuit.

Having referred to the provisions of the law affecting the project during its inception and progress, we may pass to a consideration of the provisions bearing upon the title to the water obtained upon completion of the undertaking.

The document conveying this title is termed a license, and would perhaps be better designated as a 'water patent,' but while it conveys an absolute title from the Crown it differs from the ordinary land patent in the material sense of being subject to cancellation for failure to comply with certain conditions of the law after its issue, while the land patent is subject to cancellation only for cause precedent to its issue. The term 'license' was therefore thought the better one, and a consideration of its wording will demonstrate that the title conveyed is good and the limitation thereto wise.

It will be noticed in the first place that the license purports to transfer a definite quantity of water for the irrigation of a defined area, but that the transferee, to maintain his title, must live up to the provisions of the law. These three points are worthy of separate notice.

The definite quantity of water conveyed settles at once the question of the limits of the right, and no loophole is left for advancing a claim that the right is defined by size of canal or ditch, or area of land to be irrigated. The stage at which water is granted is also indicated, and the means of determining the stage settled, so that disputes as to when a licensee is entitled to take water cannot arise, and at the same time, under the system of granting licenses against the three stages, viz.: low water, high water, and flood stage, it is possible to grant titles to all the flow of water available for diversion without prospect of a dispute between the holders of such titles.

The second point referred to opens up a subject which has been prolific of much discussion and controversy in all irrigation countries, which may be summarized as follows:—

Shall water diverted for irrigation be an appurtenant of the land for which it is originally diverted, or a moveable right available for use anywhere?

The license issued under the Canadian irrigation law answers this question in the plainest terms, provided that the water granted is granted for the irrigation of a defined area, as shown by the memorial, maps and plans of record, and not as a right to be used anywhere the licensee may see fit.

In this connection it may not be out of place to refer to some criticism of the above provisions of the Canadian law contained in the report on 'Water Rights on the Missouri river and its Tributaries,' contained in Bulletin No. 58 of the Office of Experiment Stations, U. S. Department of Agriculture.

The author of that report in speaking of the amount of the appropriation authorized by the Canadian law, states: 'The amount of the appropriation is limited by the capacity of the works, which is determined by an inspection ordered by the Minister of the Interior, and the report of this inspector is made conclusive. This is believed to be a mistake. The experience of the arid states of this country has shown that making the ditch builder the appropriator of water does not afford sufficient security to the user. It is not the ditch builder who makes the principal return, not whose interests are of enduring moment; it is the man who reclaims the land and makes his home thereon who should receive the first consideration of the law-makers who deal with the subject. Making ditch builders or canal companies the appropriators of water threatens to put users of water from those canals under a perpetual mortgage to them.'

The foregoing criticism is, it is thought, based upon a wrong interpretation of the Canadian law. That law, in common with the laws of both Wyoming and Nebraska, provides that the application to appropriate water must describe the ditch or canal through which the water is to be diverted, and the lands to be irrigated by the water granted.

The Canadian law provides (section 24 of the Act) for an inspection by the Chief Engineer upon the expiration of the time granted for construction of the ditch or canal, and the issue of a certificate by him that the completed works are capable of carrying a stated quantity of water, and upon this certificate the license is based; but the law further provides (section 26) that should it subsequently be found that the works will not carry the quantity of water granted, the right shall be limited to the quantity

which the works will carry. These provisions must be interpreted in connection with other provisions of the law and the regulations prescribed thereunder.

In the first place, it should be noted that water granted is granted for the irrigation of a specified area, and as already explained, the applicant for the water is required to file his contracts or agreements with the users owning this land, if it is not his own property, before the license issues.

It should also be explained that under the Canadian law the irrigation season and the duty of water are both fixed by the minister, and the amount of water granted is based upon the ratio between the acreage to be irrigated and the water provided by the 'duty' as being necessary to irrigate that area. The quantity of water which a user (or more properly speaking, a definite area) is entitled to get being fixed at the time of the final inspection by the Chief Engineer, he must be guided by the contracts and agreements filed in issuing his certificate, and if his inspection proves that the ditch or canal as constructed will not carry a sufficient quantity of water to enable the owner to fill his contracts in accordance with the duty of water laid down by the regulations, he has to see that contracts for lands which cannot be supplied are cancelled before issuing a certificate upon which the water for lands that can be served is granted. This system, it is thought, provides the most ample protection to the user, and although the ditch or canal owner is admitted to be the appropriator, his appropriation is limited strictly to the proper quantity required for a specified area, and the owners of that area protected in their right as acquired through the appropriation filed by the ditch owner.

The provision of the law for revision of the right acquired can be brought into force only as an appeal from the first certificate issued as to capacity of the canal or ditch, and the procedure for a second inspection and certificate can not damage the rights of the user, as the law further provides (section 35) that if a licensee can not supply all the water agreed to be delivered, each user must get his proportionate share, enforcement of this provision being exacted by a heavy fine or imprisonment, or both. Under the Wyoming law the certificate of appropriation is based upon the evidence given by the appropriator, and a recommendation from the superintendent of the water division within which the works are situated, based upon an inspection made by a qualified person. This certificate authorizes the appropriation of a definite quantity of water for the irrigation of a defined area. Under the Nebraska law the appropriation is limited to a definite quantity of water for a specified area reclaimed on a fixed date, and provision is made for the proper record of a certificate defining the quantity of water duly appropriated.

Both of the latter laws differ from the Canadian law in procedure only, as the area of land reclaimed is made the basis of the water granted, but under the Canadian system it is further provided that the ditch through which the water for irrigation of this area is to be carried must be of sufficient size to carry this water, and the right is attached to the land as an easement through such ditch.

The provision of the Canadian law for cancellation of the license illustrates one of the marked points of difference between that law and American laws relating to irrigation. Under most of the latter laws the forfeiture of rights for non-use, or failure to comply with other provisions of the law must be enforced by a legal process which is capable of long and vexatious delays. The Canadian law, on the other hand, having provided for the issue of a document which is prima facie evidence of title, also provides the simplest and most effective machinery for cancellation of the title for cause, and the result is that while the owners of water rights who live up to the provisions of the law receive ample protection in the enjoyment of these rights, without having to resort to the courts to have them defined or enforced; such a thing as maintaining a right to water unless its beneficial use is continued is not possible.

The provisions of the law relating to priority of right among the holders of licenses, and for summary settlement of disputes between licensees, will be readily understood by reference to the particular section of the Irrigation Act relating to this mat-

ter, which reads as follows:—'Licensees shall have priority among themselves according to the number of their licenses, so that each licensee shall be entitled to receive the whole of the supply to which his license entitles him before any licensee whose license is of a higher number has any claim to a supply; and if a complaint is made to the minister, or to an officer authorized by him to receive such complaints, that any licensee is receiving water from a source of supply to which another licensee is entitled by virtue of priority of right, and that the licensee having such priority of right is not receiving the supply to which he is entitled, some officer, to be named by the minister or the officer to whom complaint is made, as the case may be, shall inquire into the circumstances of the case, and if he finds that there is ground for the complaint, shall cause the headgates of the ditch or other works of the licensee who is receiving an undue supply of water to be closed, so that the supply to which the other licensee is entitled shall pass and flow to his works.

Having dealt with the procedure relating to the initial acquirement of water rights, it may be of interest to note briefly the system and forms adopted for transfer of title to the whole or any portion of the right.

Provision is first made for the transfer of the whole right covered by an application during the period of acquirement or before the issue of the license. This provision is necessitated by the fact that change of ownership may occur during the period granted by the authorization for completion of the construction of the works for the utilization of the water applied for.

After the issue of the license it may be wholly or partly transferred by use of the simple form printed on the back, and the record of this transfer having been effected, upon payment of a small fee, the transferee obtains a new license in his own name. This simple system of transfer resembles the Torrens land title system in force in the North-west Territories, and has the further advantage that the license is prima facie evidence of title.

The matter of the title of those who purchase water for irrigation from the holder of a license is important to the actual irrigator, and is dealt with in the following manner. It will be noted that the holder of a license may come within any of the following classes:—

(a) The individual who acquires a license for water for the irrigation of his own land only.

(b) The individual, or possibly association of individuals as a partnership, who acquires a license for the irrigation of its own and neighbour's lands.

(c) The company duly incorporated for the purpose of acquiring a license for water for the irrigation of large areas, of which in many cases it may own only a portion.

(d) The irrigation district organized under a special law for the irrigation of land as a municipal undertaking.

All these cases are dealt with on the same basis up to the time of the issue of the license, and the applicants must before that time have proved their title to the land for which the water is granted. The character of the title to be proved differs, however, materially in each case.

In cases which come under the heading (a) the applicant is required to hold the land to be irrigated in fee simple, or under a homestead entry, or lease from the Crown, or an agreement for purchase with one of the railways or other land owning companies.

The title in class (b) is somewhat more extended, and it is sufficient for the applicants to prove title to the land they personally hold under titles outlined in class (a) and to file agreements for the use of the water with the owners of the additional lands to be irrigated from their ditch or canal.

The larger contracts comprised under class (b) are again dealt with under a different system. The corporate bodies comprised within this class are given by the law bringing them into existence, the right to acquire water for irrigation of large areas

without it being necessary that they should own any large portion of this area. In practice it has so far been found in Canada that as a business venture irrigation companies are not a success unless the company owns the larger part of the land to be irrigated, and can realize from this land the increased value resulting from bringing it under a ditch or canal. In dealing, however, with these cases, it is required that during the period granted them for completion of their scheme, they should record agreements for the sale or use of water covering the total area to be irrigated.

As bearing upon the terms of these agreements it may be pointed out that the regulations prescribed under the Act provide among other things that the agreements must be recorded in the same central office of record from which the license issues.

The duty of water, which governs the quantity to be delivered is fixed, not by the irrigation company or water user, but by the government.

The water delivered under the agreement must be measured by a device approved by the government.

The irrigation season is fixed by the government.

A company attempting to enter into an agreement to supply more water than its canal will supply shall be punished by a heavy fine; and that

Disputes between the company and the user as to quantity of water delivered are settled by government officials without recourse to the courts.

The title of users of water under class (d) is again dealt with in a manner different to cases comprised within classes (a), (b) and (c).

In this instance the district requiring a license is simply holding it in trust for the landowners comprising the district, and as under the irrigation district law, referred to more fully further on, all the irrigable land in the district must use and pay its share of the water tax, no special agreements are entered into between the district and owners of irrigable land, and before issuing his certificate for the license the Chief Engineer has only to satisfy himself that the works as constructed will carry sufficient water to enable all the irrigable land in the district to get its share, the title of this land to the water being defined by the law creating the district.

There are, in addition to the foregoing, many other general provisions of the Canadian irrigation law which are deserving of consideration, but the main features bearing upon the title to water acquired under the Act have been dealt with, and the remaining points may be noted by those interested in the matter from a consideration of the law itself.

Before concluding, however, it is necessary to refer to the second law mentioned in the opening paragraphs of this discussion, the North-west Irrigation District Ordinance.

This enactment has in view the introduction of irrigation works as municipal undertakings, and is based on the principle that an irrigation canal constructed for the reclamation of any area should be held in common by the owners of the lands to be irrigated.

The ordinance provides that by petition addressed to the Lieutenant Governor in Council, a majority of the owners in any specified area may secure the erection of such area into an irrigation district, and proceed to elect from among themselves a board of trustees to manage the affairs of the district. Notice of the application for the erection of the district must be given in a local newspaper, and proper evidence furnished as to the good faith of the signers of the petition and the genuineness of their signatures.

The district being properly formed, they then proceed to make application under the Irrigation Act for a water right in exactly the same manner as an individual or company, and their application is subjected to the same scrutiny to determine the feasibility of the scheme and the ability of the district to carry it out.

If the application for a water right is granted, the district proceeds to raise the necessary money for the construction of the proposed works by the sale of debentures based upon the land comprised within the district as security, but must first obtain the

approval of the Lieutenant Governor in Council to the proposed debenture issue. Having secured the necessary money, the works are constructed under the same conditions as to inspection and approval by the Chief Engineer as are enforced with regard to private or other corporate irrigation works, and after completion, the canal is managed and maintained by an annual tax upon the irrigable land in the district sufficient to pay the cost of management and maintenance, and provide a sinking fund to redeem the debentures.

It should be noted in connection with this law that the same scrutiny and care are exercised in the formation of the district and the acquirement and exercise of its water right that are exercised with regard to private or other corporate rights acquired under the irrigation law.

There is one provision of the Irrigation District Ordinance which is deserving of special notice, because its enforcement has had the result of enabling irrigation districts in Canada to dispose of their debentures at a price above par, and it effectually prevents anything like speculation in the organization of districts, or investment in their debentures except as purely interest-bearing securities. The provisions referred to provide a practical guarantee by the government of the debentures which a district is authorized to sell, and contain the law, unique on this continent, that if the landowners of the district neglect to pay the tax imposed for the management and maintenance of their irrigation works, and to provide a sinking fund to pay off the debenture indebtedness, the government pays these taxes and takes the lands.

The practical result of this provision is that the district is absolutely sure of its revenue for management and maintenance, and the debenture holder of his interest and principal, while those who might be disposed to seek the formation of irrigation districts in the speculative hope of obtaining cheap land have very little encouragement to indulge in such enterprises.

In conclusion it may be pointed out that while our laws relating to irrigation are in their infancy or formative stage, and possibly weak in many respects, the guiding principle and aim of these laws and their administration is 'security of title and the use of the available water supply for irrigation in such a manner as to bring the greatest and most lasting benefits to the greatest number.'